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In this Issue

Regular Features

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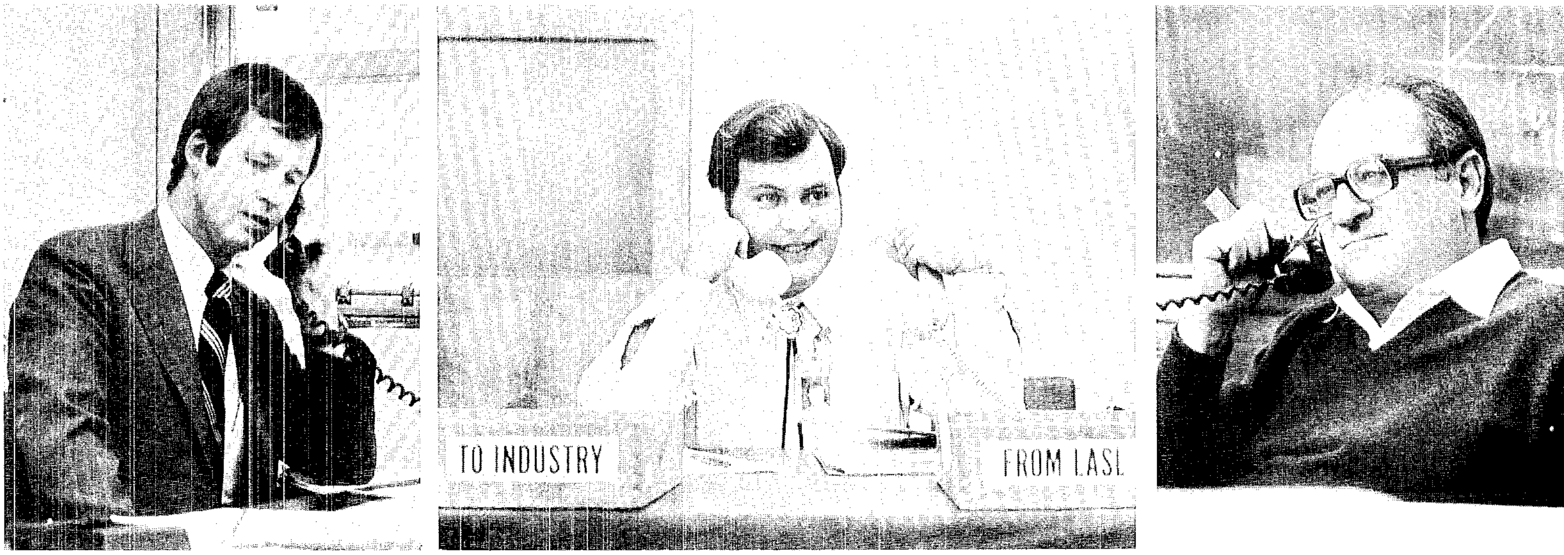
Cover

by Bill Jack Rodgers

Singing with revolutionary spirit to begin Los Alamos' Bicentennial celebrations are Tim Burns, Eric Jones, J-10, Roger Lazarus, C-DO, and, seated, Karen Stapleton in the Light Opera's production of *1776* now at the Civic Auditorium.

Below, John Lunsford, CMB-8, Sandy Musgrove, and Don Gerheart, all of the production staff, test scrap metal to find pieces that ring like bells during the months of preparation that preceded opening night. For more on *1776*, see page 12.



The man in the middle—in more ways than one—is Gene Stark, head of LASL's newly created Technology Liaison Office. Recently he was instrumental in bringing Public Service Company executives, such as David Bedford, left, together with LASL energy researchers, such as Bill Keller, Q-26 group leader, right.

From LASL to Industry with Love

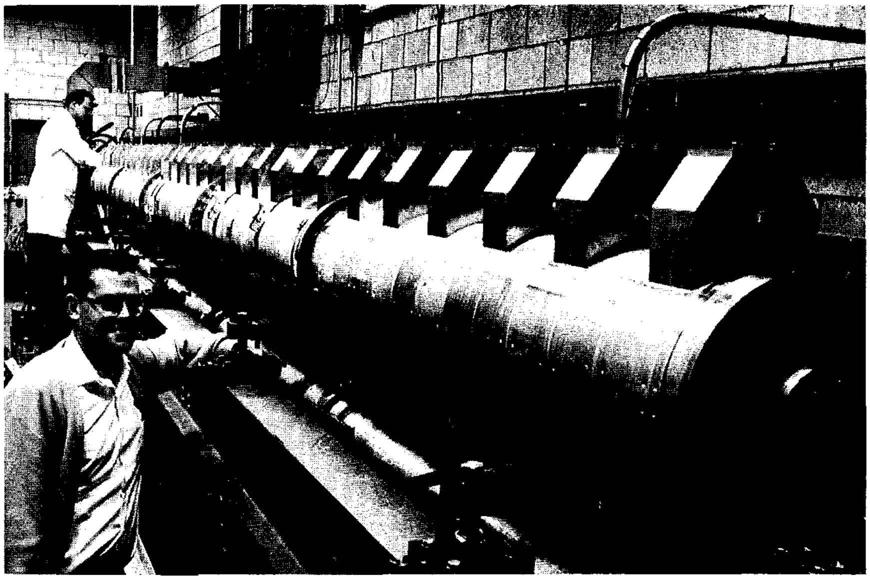
It's a familiar, but always inspiring story: how the research of today becomes the products of tomorrow. Some well-known examples are nuclear power and, more recently, lasers and computers. The transfer of technology from laboratory to industry has resulted in new plants and jobs whose value, if it were calculable, would be measured in hundreds of billions of dollars. Few argue that investment in scientific research and development is one of the most profitable that society can make.

The need for getting technology from the laboratory to industry is more urgent than ever before. President Ford recently said, "The expansion of knowledge through scientific research and the successful and creative employment of our scientific and technological capabilities are essential to the growth, stability, and security of the Nation. Today, advancement in these fields is crucial, for example, to the achievement of our long-range energy independence."

With the demise of the U.S. Atomic Energy Commission (AEC) and the advent, less than a year ago, of the U.S. Energy Research and Development Administration (ERDA), the business of transferring the technology developed in the laboratory to industry may take on new impetus. In its early years, the AEC had little incentive to develop a large-scale technology transfer system because the overwhelming preponderance of its activities was in weapons, a technology that the AEC definitely did not wish to transfer. Although increasing attention was paid to technology transfer in the AEC's later years, in conjunction with its greater diversification into nonweapons research, it is not surprising that ERDA inherited no elaborate "machinery" for technology transfer.

With ERDA less than 1 year old, there has still been no significant alteration in the ways technology is transferred. Yet, there are signs of changes in the making. In a statement recently before the House subcommittee on Conservation, Energy, and Natural Resources, ERDA Administrator Robert Seamans said, "I cannot stress too strongly that ERDA's mission can ultimately be accomplished only through the transfer of proven energy technologies in the private sector for widespread application."

At least 2 posts in ERDA's organization chart are related directly to technology transfer. Farwell Smith is the director of the Office of Industry, State, and Local Relations, the departments of which include those for Research and Development Commercialization, In-



Side-coupled radio-frequency cavities, developed for the third stage of the LAMPF accelerator beam, have also revolutionized the manufacture of clinical radiotherapy and radiography equipment. In this 1964 photo, Ed Knapp, MP-3, and a principal investigator of the cavities, is shown by prototypes being tested during an early stage of their development.

dustry Policy, and Technology Utilization. Ed Stokely is Assistant Director for Technical Information, Office of Public Affairs, whose function is to answer inquiries and publish information on new technologies.

And at LASL, Gene Stark, formerly of L-Division, has been named head of the newly created Technology Liaison Office. Stark plans and implements strategies for working with industry, fields inquiries from industry, and relays them to the proper division or group and, conversely, informs various LASL divisions and groups of industry's current interests and needs. As an example, Stark recently interested a group of Public Service Company of New Mexico executives in LASL's energy programs, following which he arranged a visit which included meeting Bob Duffield, Q-Division leader, Bill Keller, Q-26 group leader, Dean Taylor, Q-26 associate group leader, Mort Smith, Q-22 group leader, and Ken Herr, Q-24 alternate group leader. Stark will continue to act as liaison until such time as one or more programs in conjunction with Public Service Company may materialize.

Long before the creation of Stark's post, of course, those divisions and groups whose activities related in some way to "outside" industry had been involved in liaison and technology transfer. Most notable is Group MP-3 (practical applications) at the Clinton P. Anderson Los Alamos Meson Physics Facility (LAMPF), one of the first MP groups formed when LAMPF went on line in 1972. LAMPF was "sold" in Washington, D.C., primarily on the basis of its research potential, but with the promise that immediate practical applications would be pursued. Group MP-3 appraises basic research programs at LAMPF for possible practical application, originates those kinds of programs that appear to have potential practical application, and conducts its own basic research and development for these programs. A notable example is a promising localized heat therapy for cancer now being tested at the University of New Mexico Medical School (*The Atom,* Sept.-Oct. 1975).

As Ed Knapp, MP associate division leader for practical applications and MP-3 group leader points out, the nature of MP-3's activities differs fundamentally from those of Stark's office which is concerned only with liaison. Group MP-3 is essentially a research group whose liaison is incidental to their total activity.

Technology can be thought of as "hard," or tangible devices, and "soft," or information useful to others in their development of new products. The immense flow of soft technology from LASL, presented at scientific, technological, and industrial meetings, and printed as papers and in scientific journals, is impossible to document and trace through to its final practical application. Nonetheless, in the long view, the value of soft technology may exceed that of hard technology in terms of benefits to society.

Hard technology, on the other hand, is easy to identify and trace. It provides specific, often dramatic, examples of technologies developed at LASL which are now being applied by—or appear likely to be applied by—industry.

Side-Arm Pitch for Particles

One of the most dramatic of these examples is the side-coupled radio-frequency cavity developed at LAMPF. It has literally revolutionized an industry whose total sales to date of clinical equipment incorporating the side-coupled cavity now exceeds the cost of the facility for which it was designed.

Beginning in 1965 with Congressional authorization for architectural and engineering work for LAMPF, development began on a then-new and completely different type of cavity for the third stage of the linear accelerator. Cavities are the basic "building blocks" of an accelerator, a chain of them providing the sequence of impulses that accelerate charged particles.

In conventional accelerator design, the radio-frequency power required to accelerate the particles is distributed between a string of cavities through the same hole used to transmit the particle beam. The side-coupled cavity, as developed by Knapp, Darragh Nagle, alternate MP-Division leader, Bruce Knapp, formerly MP-3, and Jim Potter, MP-4, consists of forged copper cavity units which distribute their power through couplings located at the side of the cavity. Inherent in the physics of the concept are clear-cut advantages such as higher efficiency (only half the power of conventional designs is required), more precise control, and simplicity in final alignment of the radio-frequency field levels.

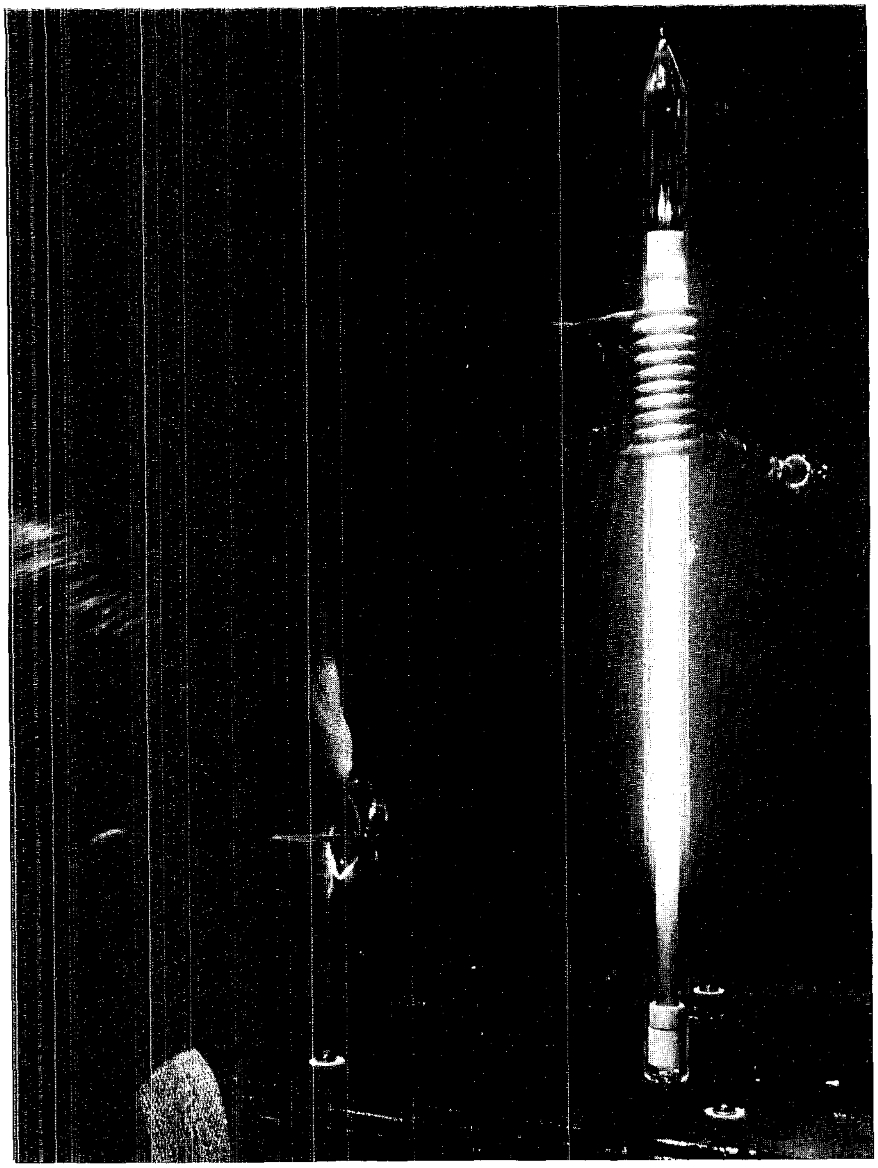
The transfer of this particular technology from LASL to industry began at a meeting in 1967 when Knapp presented a paper on the subject. Representatives of Varian Associates, Inc., of Palo Alto, California, recognized the advantages of the new cavity for clinical x-ray and radiography equipment and later began manufacturing the cavities. Since then, SHM Nuclear Corporation, Sunnyvale, Calif., and Applied Radiation Corporation of Walnut Creek, Calif., have also become manufacturers of clinical equipment incorporating the cavity. To date, more than 350 pieces of equipment using the side-coupled cavity have been produced, most costing $150,000 or more. In addition, more powerful second-generation models are now appearing on the market.

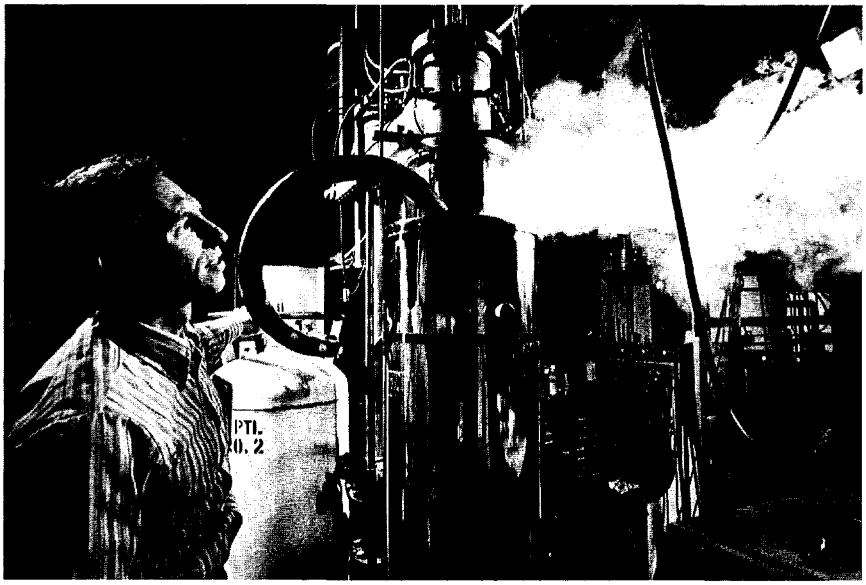
Other technologies, aside from the previously mentioned localized heat therapy for cancer, at various stages of development and which appear destined for eventual transfer to industry, include an electrosurgical tool, a sensing device placed in brassieres for early detection of breast cancer, and a 3-dimensional charged-particle system for clinical radiography.

Keeping Permafrost Cold

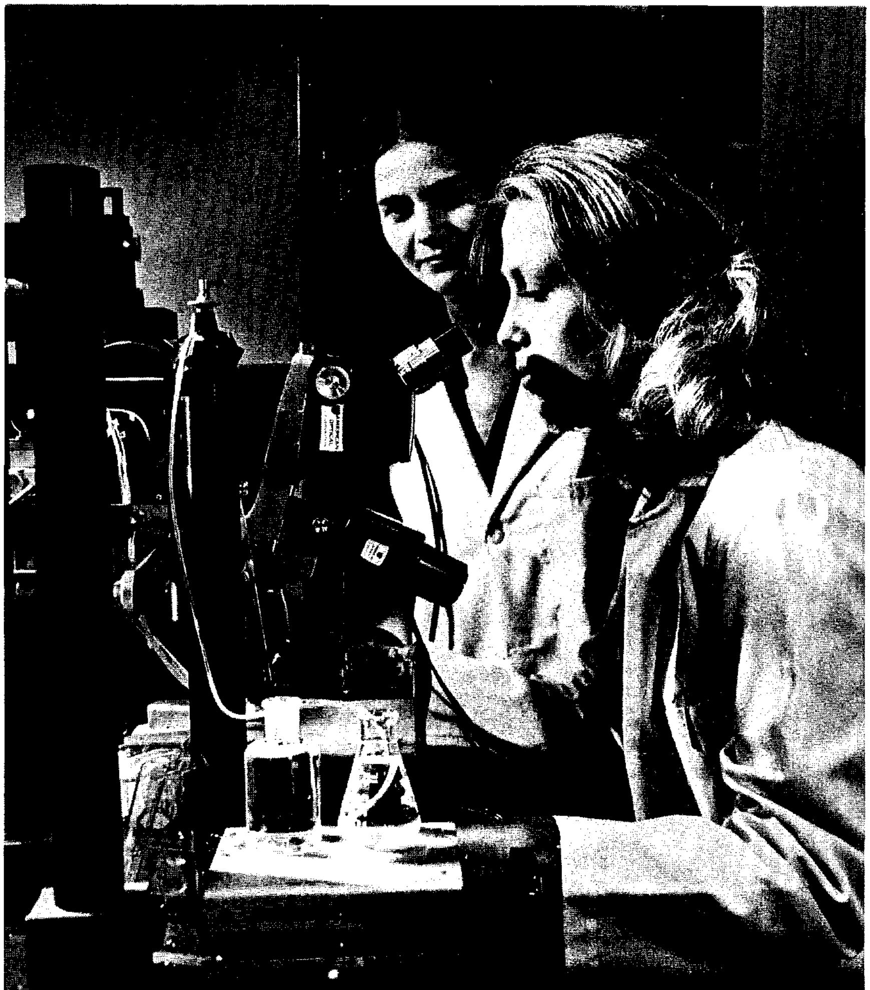
Among the many programs conducted by LASL for the National Aeronautics and Space Administration (NASA) was the development of a novel device in 1966 to transfer heat from one side of a satellite to the other to prevent extreme heat differentials from being generated. Such control was needed to prevent damage to delicate electronics.

Heat pipes, being used on the Alaska pipeline, hold immense promise as very simple, extremely efficient devices for transferring heat in a great number of industrial applications. Here, the inventor of heat pipes, George Grover, formerly N-5 group leader, watches a laboratory model "do its thing" for a photo used on the cover of The Atom in 1966.





A sample of a superconducting transmission line in a dewar of liquid helium is tested by Roger Bartlett, Q-26. Extreme cold is required to eliminate resistance. The technology may eventually find its way into the nation's electric power system to save huge amounts of energy that today are lost in long-distance transmission. Below, research and development of cell-sorting instruments, here being operated by Karen M. Hansen and Mary Jane Hagenson, H-10, is ongoing at LASL. Using lasers and computers, the technology is being introduced into industry as a fast, accurate method of analyzing and sorting biological cell specimens.



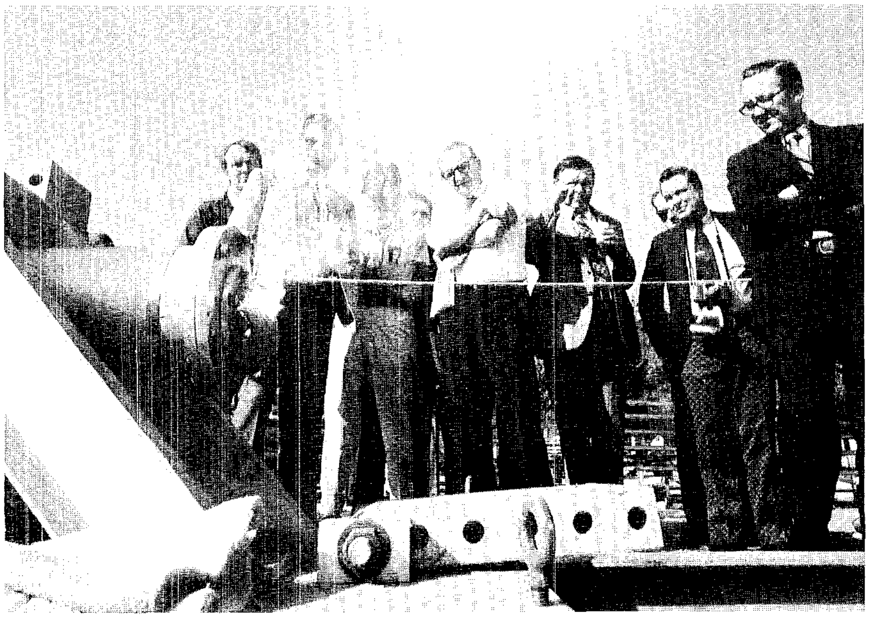
Named a "heat pipe," the device consists of a tube whose inner wall is lined with a wire screen. Within the tube is a fluid. Heat at one end of the tube vaporizes the fluid which then, as vapor, moves to the opposite end of the tube where it releases its heat to a cooler environment, condensing in the process. In liquid form, it then returns to the hot end by wicking through the lining. Fluids may be formulated for operation in temperatures ranging from below 0° to 2000° Celsius.

Like so many devices of such elegant simplicity, the heat pipe works with high efficiency and reliability. Only small temperature differentials are required to actuate and perpetuate the cycle. There are no pumps or moving parts to wear out. It was obvious to the inventor, George Grover, then Group N-5 leader (now vice president for research of Q-DOT Corporation, which he was instrumental in founding), that the device could have widespread practical application on earth as well as in space.

And indeed it has. A recent report by NASA on spinoff benefits to industry says ". . . Isothermics, Inc., New Jersey, was formed in 1971 to market heat pipe products . . . $700,000 sales in 1972, over $1.5 million sales in 1974 . . . over half of sales are for heat pipes that recover waste heat from furnace flue gas . . . project $2 million sales in 1976."

The greatest benefits of the heat pipe may lie ahead. Q-DOT, Hughes, and Dynatherm are working on systems for industrial waste-heat recovery and utilization, and Group Q-25 has just completed a heat recovery unit for a metals refining company. But, future benefits aside, it was recently estimated that heat pipes in existence now are saving the energy equivalent of half a million barrels of oil per year.

The heat pipe has also become a consumer item, manufactured under the brand name, "Twice As-fast," a device to transfer oven heat to the interior of roasts to reduce cooking time.



A live demonstration of the subterrene, here being made before a group of industry and government officials in Virginia in 1973, is an example of how LASL often takes its developments "outside" to introduce a new technology to interested groups. LASL personnel frequently attend trade and technical gatherings for this purpose.

But the most dramatic and largest single application of heat pipes is for the Alaska Pipeline, in which a 390-mile section must be supported above the permafrost. Permafrost is firm when frozen, mushy when thawed, and engineers needed a device that would prevent heat from the pipeline from thawing the permafrost, allowing the pipeline supports to list or topple.

As NASA reported, ". . . commercial heat pipe products developed by MDC (McDonald Douglas Corporation, Washington) include Cryo-Anchor soil stabilizers to prevent thawing of permafrost under structures in the far north . . . eliminates serious foundation stability problem . . . MDC received $13 million contract from Alyeska Pipeline Service Company, Alaska, to supply over 100,000 Cryo-Anchors . . . will be installed around pipe supports. Cryo-Anchors are 2 or 3 inches in diameter and range in length from 30 to 60 feet."

As Luck Would Have It

In 1972, at a meeting in Washington, D.C., a man familiar with LASL's program for developing superconducting dc transmission lines mentioned this to Consolidated Edison's director of research, Robert Bell, and introduced him to Ed Hammel, assistant director for energy. Hammel learned of Con Edison's intention to build a 600-meter dc test link at the company's Astoria, Long Island, substation in 1980. As a result, plans are set for installing LASL-developed superconducting dc transmission lines for testing in Con Edison's test link.

Buying Power

An important *de facto* method of introducing a new technology into the mainstream of industry is by contracting with private companies for specific items manufactured to LASL specifications. Normal bidding procedures are used to assure equal opportunity to qualified companies. In some cases, the item could have been produced at LASL. However it is in the national interest to develop outside sources as well as to foster the dissemination of LASL-developed technologies. Often, the dollar amount represents little, if any, company profit. However, the contract may enable the company to pay for much of its tooling, training, and start-up costs, thus enabling it to later enter commercial markets at an advantage.

CTR-Division, with its involvement in high-voltage technology in connection with the building of its many magnetic confinement devices, is frequently involved in this type of transfer. Among the devices that have been designed by CTR-Division and manufactured by private industry are superconducting switches, capacitors, and multichannel spark gaps. A number of other developments in the making include plastic dewars for energy storage coils, helium refrigeration systems, and wire for alternating current superconductors. One LASL technology, developed by CTR-Division, is magnetic swaging, or using pulsed magnetic fields to form metals. This technique is used to form, among other things, metal baseball bats.

An Equal Technological Employer

Many LASL developments are patentable, and patents are filed by the U.S. government. The philosophy of the U.S. government is that tax-supported research and development by national laboratories, such as LASL, must be available equally to all.

Thus, quite a few hardware items developed by LASL are manufactured by several manufacturers, such as a biological cell sorting machine which is made by both Particle Technology, Los Alamos, and Becton-Dickinson.

This equal-opportunity philosophy is not without its drawbacks. At times manufacturers are reluctant to manufacture certain items without the competitive edge that a patent, or exclusive licensing, would provide. This is true especially for items with high start-up costs and for which no immediately profitable markets are apparent.

Sometimes more development, at company cost, must be done. As an example, at least one manufacturer declines, at this time, to manufacture the subterrene, the drilling device originated by Group Q-23 that melts its way through rock. Nonetheless, it seems likely, as the technology is advanced and economic factors change, developments such as the subterrene will eventually be introduced. Stark is now working with Q-23 in developing an industry-partnership plan to bring this about.

The doctrine of equal opportunity extends to the ways LASL does business with industry. Company representatives visiting or in other ways contacting LASL are given equal information and consideration. "We bend over backward to be impartial," says Knapp. "So far, no one has accused us of giving an inside track to any one company."

Nevertheless, LASL can be, and often is, selective in its dealings when contracting for joint research and development ventures supported by ERDA. For instance, to achieve its goal of developing a practical solar heating system for mobile homes, Doug Balcomb, Q-24, contacted a number of mobile home manufacturers to find one willing and able to participate in building LASL-designed prototypes. In addition to obtaining prototypes for testing, LASL would expect to learn of unexpected production bugs and cost problems that can best be learned on the plant floor.

The companies selected were Industrial Systems Engineering, Inc., Albuquerque, for engineering, and Albuquerque Western Industries, Inc., for manufacture. The technology will be available to all. Whether either company earns a meaningful profit from the project remains to be seen, but both will have gained an intangible asset called know-how, the payoff of which may come should they ever decide to enter the solar-heated mobile-home market.

What's Ahead?

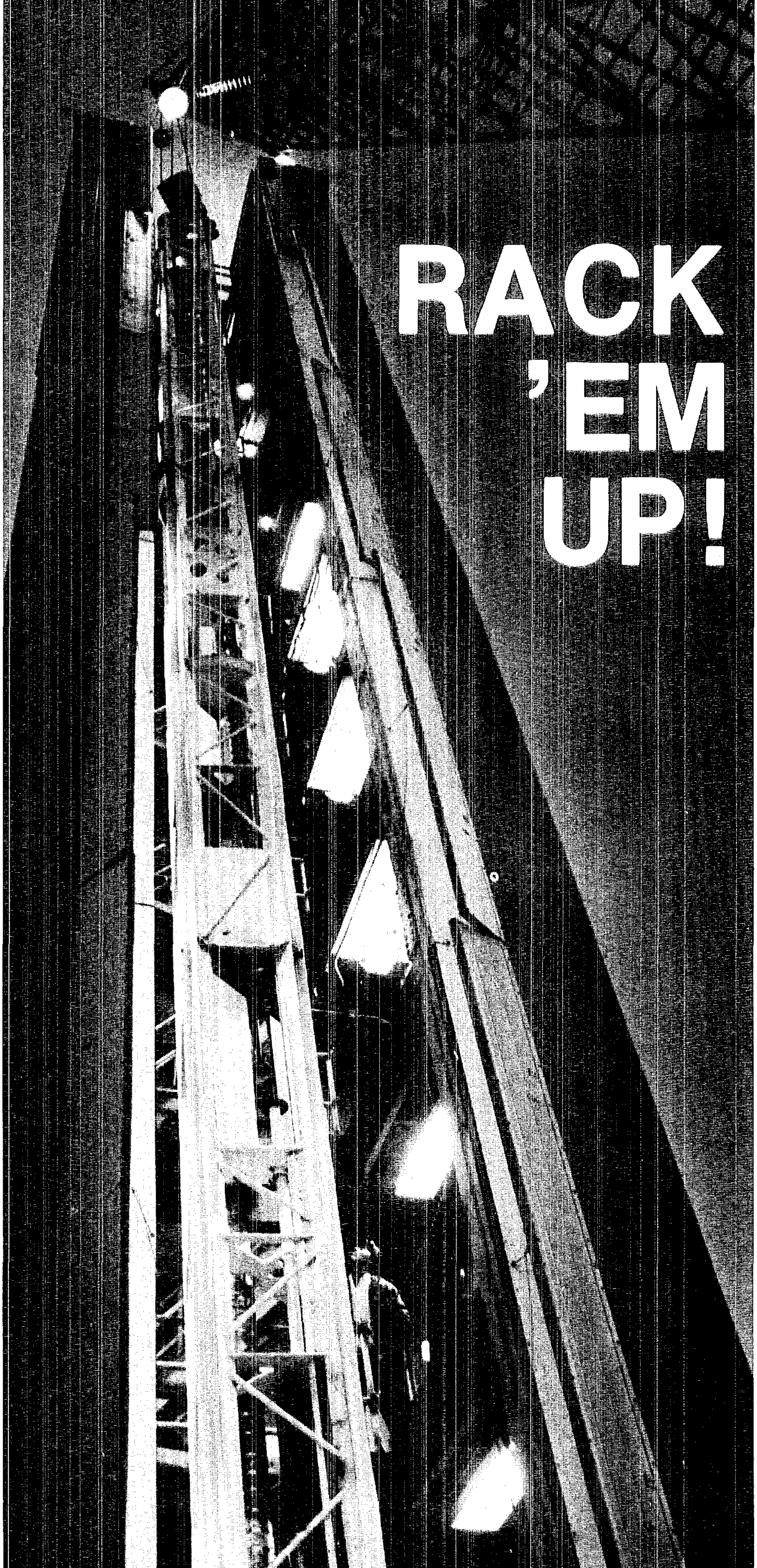
In fact, the methods of transferring technology to industry, varied, decentralized, and sometimes happenstance as they may be, appear to have worked rather well. Whether they would work better in a more formal, structured, and centralized format is debatable—there is always the concern that the growth of a new bureaucracy could be self defeating. On the other hand, the development of a more formal structure might serve to bring more companies, especially smaller ones remote from national laboratories and who have little or no experience in dealing with government research, "into the act."

Meanwhile, technology transfer goes on, transforming our lives and returning to society manyfold the investment in research and development it has made.

Other LASL Contributions

No single article could list all of the technological contributions LASL has transferred to industry, medicine, and society. Here are additional examples, not named in the article, of some notable technologies which either have been transferred or show promise for eventual transfer:

- An electronic identification system for livestock, which also reports temperature, is under development for the U.S. Department of Agriculture by Group H-6 and E-Division (**The Atom**, September-October 1975). A potential market for 100 million units exists.
- Group CMB-1 has developed a spectrophotometer for automated analysis of uranium, plutonium and other "scrap." This technology will be transferred to industry after evaluation by ERDA and the National Regullatory Commission.
- Berlyn Brixner, M-5, perfected the design of rotating mirror, high-speed framing cameras, on which many commercial cameras are based.
- CMB-Division has developed a graphite-ring manufacturing process for Cummins Diesel, chemical vapor deposition techniques widely used in industry, a thermochemical hydrogen production technology that is being studied by General Atomic Corporation and Westinghouse Corporation, magnesium oxide and ceramic crucibles manufactured by the 3-M, Norton, and Carborundum corporations, and induction-heating technology that has fostered a whole new industry.
- A-Division has been a leader in the development of nondestructive assay methods for nuclear material, mobile laboratories, monitors for the analysis of effluents (a full-scale system will be installed at the LASL liquid waste treatment facility), and other technology for inventory control and safeguarding of nuclear materials. Some of the companies using this technology are ARCO-HEDL, General Atomic Corporation, and Goodyear Enrichment.
- C-Division has made many contributions to computer technology in computer-aided learning, Braille recognition, image enhancement, interactive computing, graphic computing, and the development of special codes, many of which are available through the Argonne Code Center. E-Division has made many advances in the development of mini- and microcomputers.
- LASL developed a widely used radiation-gauging device which uses radiation to make fine measurements in material thickness, such as in metal-rolling mills. The technique is also used to check the filling of beer cans and cigarettes.



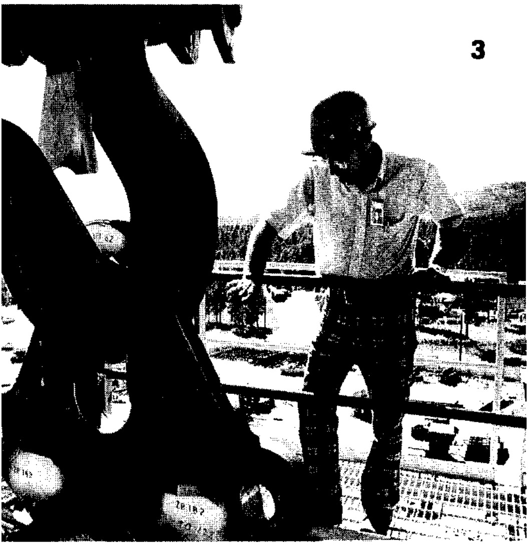
RACK 'EM UP!

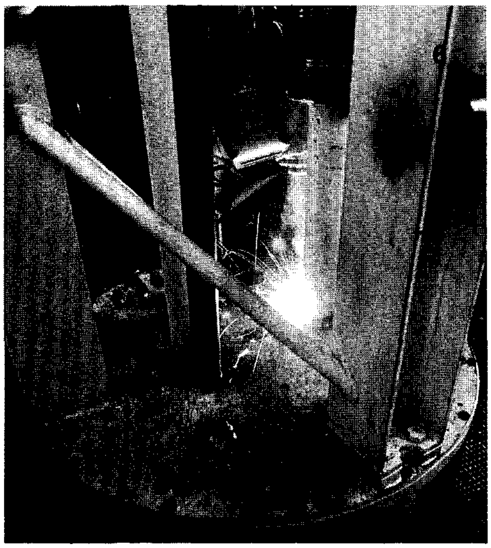
Group J-7 is one outfit that doesn't build many monuments to itself. Their main business is designing the skinny steel "skyscrapers" more than 10 stories high which become the surprisingly complex and devilishly temperamental downhole racks that hold nuclear devices and diagnostic instruments for underground tests at the Nevada Test Site (NTS).

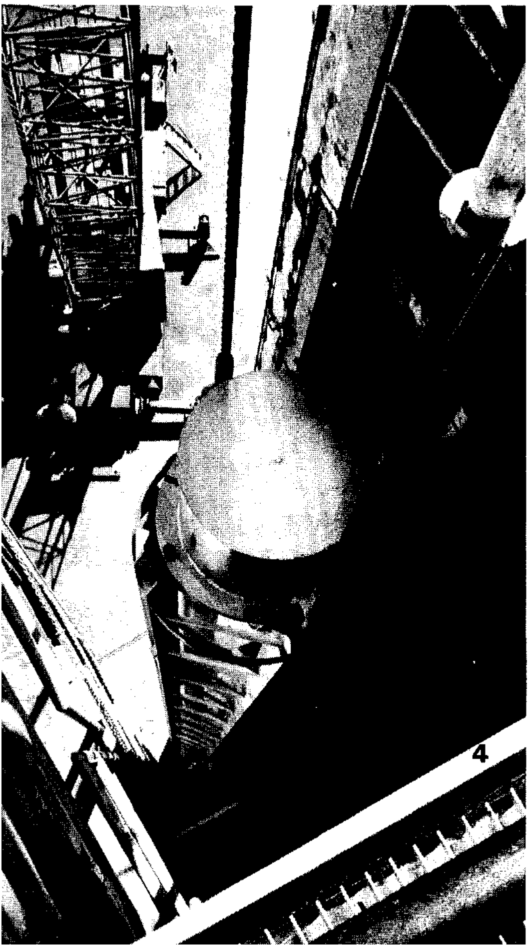
The group also does a few other things in connection with downhole testing, such as placing special hardware in towers at the surface. One of these may be a monument of sorts. As Ron Cosimi, J-7 assistant group leader, explains with a smile, "We had built such a tower in 1968 for Project Pommard—we used the names of wines in those days as project names—and had painted a bottle of wine and a wine glass on the tower. After the test, we found some radiation at the bottom, but not at the top, of the structure. It was decided to dispose of the tower by partially burying it. Today you can see part of a tower with the wine bottle and glass painted on it sticking out of the ground at Area 3 at the NTS. I guess you could call this 'billboard' our monument."

But J-7 is not concerned with monuments, just in keeping up with the increasing sophistication and complexity of modern underground testing. Early racks, in which the nuclear device and only about 6 instruments were mounted, were but 30 feet long. Today the racks are built in 2 sections which are assembled to form a rack 165 feet long by only 45 inches in diameter. Within this narrow structure some 14 detectors may be mounted, plus 6 TV cameras. The cameras, as with everything associated with tests, are something special—fast scanning instruments to record events measured in thousandths of a second.

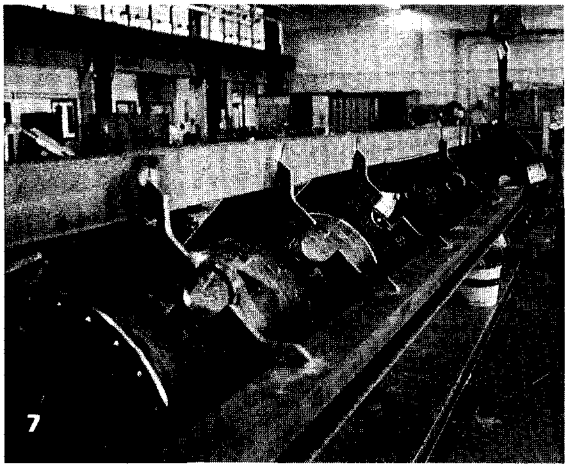
When assembled, the structure may weigh 100,000 pounds, including up to 40,000 pounds of lead shielding. More than 100 cables for firing and diagnostics are integrated into the rack design.

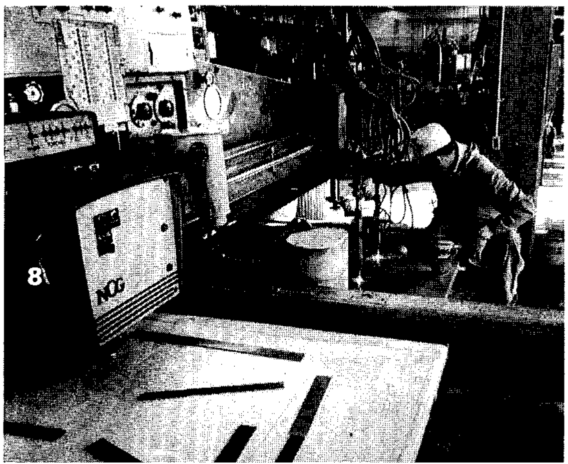






(1) Keith Daun and Chuck Johnson (background), both J-7, operate a computerized, interactive graphic system to produce drawings rapidly, which are then transmitted to an automated plotter (2) for very fast drawing, here observed by Jerry Beatty, J-7 assistant group leader. (3) High atop a tower at a Zia Technical Area, Ron Cosimi, J-7 assistant group leader, looks down on (4) a rack with laser unit encased at top, being maneuvered into position. (5) Joe Garcia, Zia, begins the tricky business of joining the rack's top half to the bottom. It didn't fit, but a Zia welder (6) changed things to make it fit. (7) Meanwhile, in the Zia shop, another rack takes shape, showing that it is more than a frame. (8) An automated pattern burner operated by Elias Velarde, Zia, follows lines on a drawing, foreground, to cut 2 parts at a time for the new rack.





The trick in "racking up" all this is in giving each diagnostic instrument a clear line-of-sight "shot" at the nuclear device. Positioning instruments up and down the narrow structure so that one won't "shadow" another becomes an intricate process. The top of the rack must be aligned to within 1/16th of an inch with respect to the bottom, a degree of precision unheard of in conventional steel construction. To accomplish this, the rack is "tuned" with laser beams which are aimed down line-of-sight pipes in which crosshairs are mounted at intervals. Early short racks required only 1 line-of-sight tube; today's racks require alignment of quite a few more.

Temperature is the main bugaboo in this touchy alignment process. For this reason the steel structure is painted white to reflect solar heat, and the rack is assembled and "tuned" in a tower. Even so, finer adjustments are made in the evening to eliminate solar effects completely. "To us, that rack is a cantankerous thing like a buggywhip bending every which way. Differences in temperature between the sunny and shady side distort the rack so that the image on the laser target follows the sun like a shadow on a sundial," Cosimi says.

Following Project Keelson

To get a clearer idea of just what designing and building a rack entails, *The Atom* "followed the trail" of the rack for an underground test planned at the NTS this winter. By the time you read this, the rack will have been disassembled and shipped to the NTS. "We build and assemble the racks in Los Alamos, make sure everything fits, tune them, then take them apart and ship them. That eliminates a lot of problems and possible delays at the NTS. Of course, the assembly and tuning must be repeated at the NTS in a tower over the downhole itself, but at least we know we'll be pretty close to 'right on,' Cosimi explains.

The value of this procedure was evident as steelworkers of the Zia Company attempted to join the 2 sections for the first time in the tower at the Zia Technical Area on West Jemez Road in early October. While the tower is a tall and conspicuous structure on the Los Alamos landscape, it only tells half the story of the rack's height; the first section is sunk into a 100-foot well.

The 2 sections are joined by bolts; unaccountably, several holes of the rack failed to align by ¼ inch. Nobody was perturbed. Out came acetylene torches and welding equipment. Within hours, the braces were cut and rewelded so that the holes would align. "Those Zia guys can do just about anything with steel," Cosimi remarked admiringly.

Diplomats, Too

The design for the rack had its inception some 5 months ago when the test's objectives were first defined by TD-Division (Theoretical Design) and ADWP (the office of the Assistant Director Weapon Planning). Involved were 12 groups, each with 1 or more experiments. Once diagnostic requirements were determined, Group J-7 went to work to solve the intricate "jigsaw puzle" that placing the diagnostic equipment in the rack represents.

"We used to do it by just sitting down and sketching some layouts," Larry Rice, J-7 group leader, explains. "But now things have become so complicated that we also use a great deal of computer time in arriving at workable arrangements."

But engineering is only part of the process. The groups involved must concur in the arrangements. Frequently, one group will raise technical objections to the placement of another group's instruments in proximity to theirs. Solutions must be found, compromises made. It becomes a matter of give and take and, sometimes, skillful negotiations. "Some of our guys should be in the State Department," Bill Dudgeon, J-7 alternate group leader, comments.

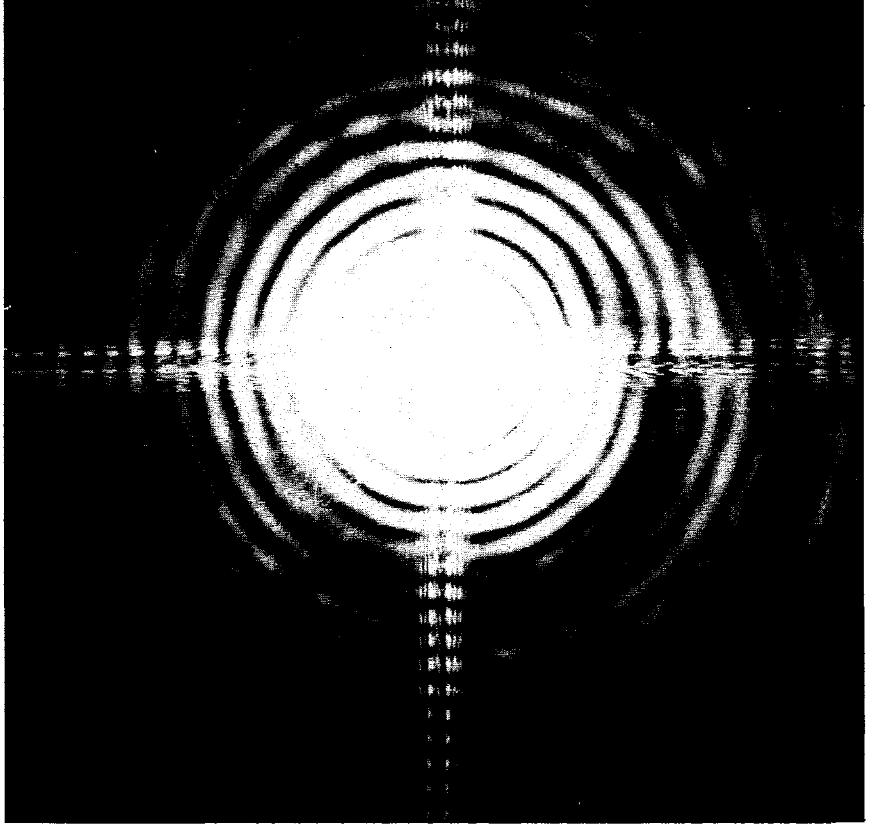
Once the design is agreed upon, making the drawings begins—hundreds of them for a typical rack of today. "These racks are all essentially custom jobs," Jerry Beatty, J-7 assistant group leader, says, "although we have standardized to some extent upon the structural framework. The manhours involved, if we were to rely solely on engineering draftsmen, would be substantial. Recently, we have acquired a computerized, interactive graphic system linked to a plotter that takes our final graphic display and draws it in pen and ink with virtually perfect accuracy."

Automation doesn't end in J-7's drafting room. Full-size drawings for parts to be cut from sheet steel are sent to the Zia Company's steel fabrication shop in the vicinity of the assembly tower. There a pattern burner follows the lines on the drawing and signals an acetylene torch to cut steel to a shape identical to the pattern. The precision of the cuts is far greater than can be achieved by hand-cutting, the process is faster, and the machine can cut several parts at a time to further enhance savings.

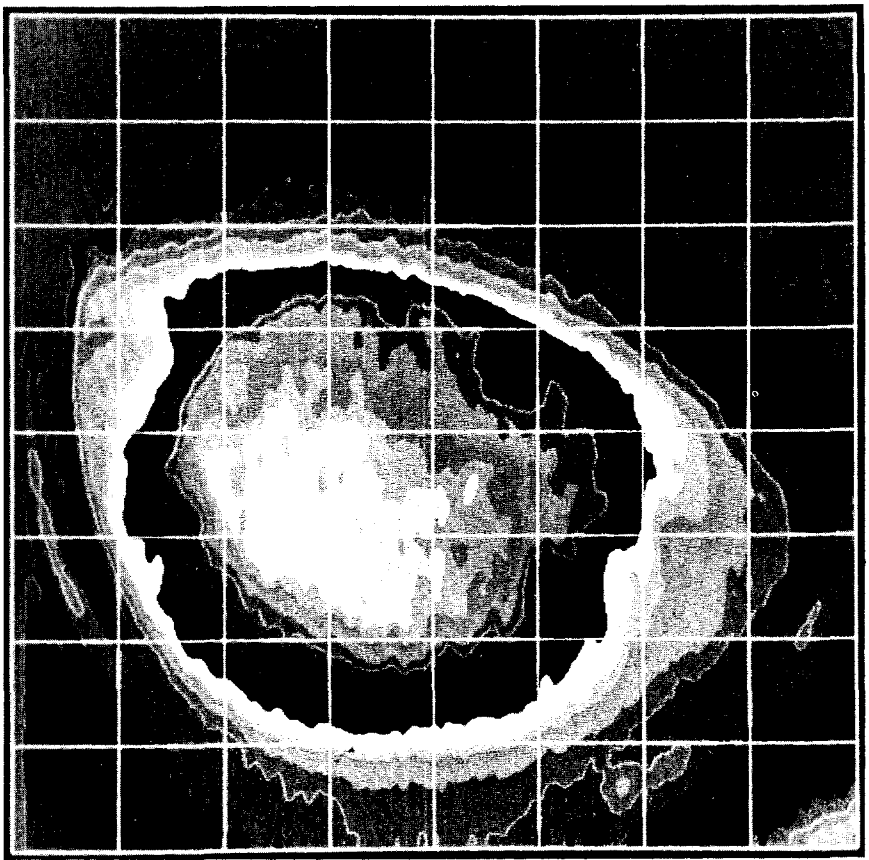
The work doesn't end for Group J-7 when the rack is dissassembled and shipped, either. From 6 to 8 members of the group will live at the "Mercury Hilton" at the NTS for 6 to 8 weeks supervising the reassembly, the retuning, the placement of diagnostic equipment in the rack, the cable hookups, and the lowering of the readied rack deep into the hole.

For a very deep shot, Group J-7 will provide refrigeration for the test device to maintain its temperature at 70-80°F against a background of much higher temperatures encountered at great depths in the earth. Some of the diagnostic equipment requires the formation of vacuums, and the group provides this support, too.

Repeat all this for many racks a year and it is easy to appreciate that Group J-7's 20 personnel have plenty to keep them busy along with



A laser beam, directed down a line-of-sight pipe 165 feet to the target, would form this image showing defraction rings and cross hairs. Laser is used to align tall racks to 1/16 inch. Below, an underground test device is detonated, producing a pattern whose density and temperature differentials are interpreted by computer. A split second later and the rack and its diagnostic instruments will disappear.



the steelworkers of the Zia Company who put it all together and make it come out right.

All This and Savings, Too

At first glance, the obliteration of perhaps $140,000 worth of rack, of TV cameras costing $10,000 each, and of diagnostic equipment frequently carrying price tags of the same order, seems an expensive way to go in nuclear testing. However, compared to the immense multi-million-dollar logistics for staging atmospheric tests in remote areas of the Pacific, even if this were possible today, underground testing in Nevada seems like a bargain, indeed.

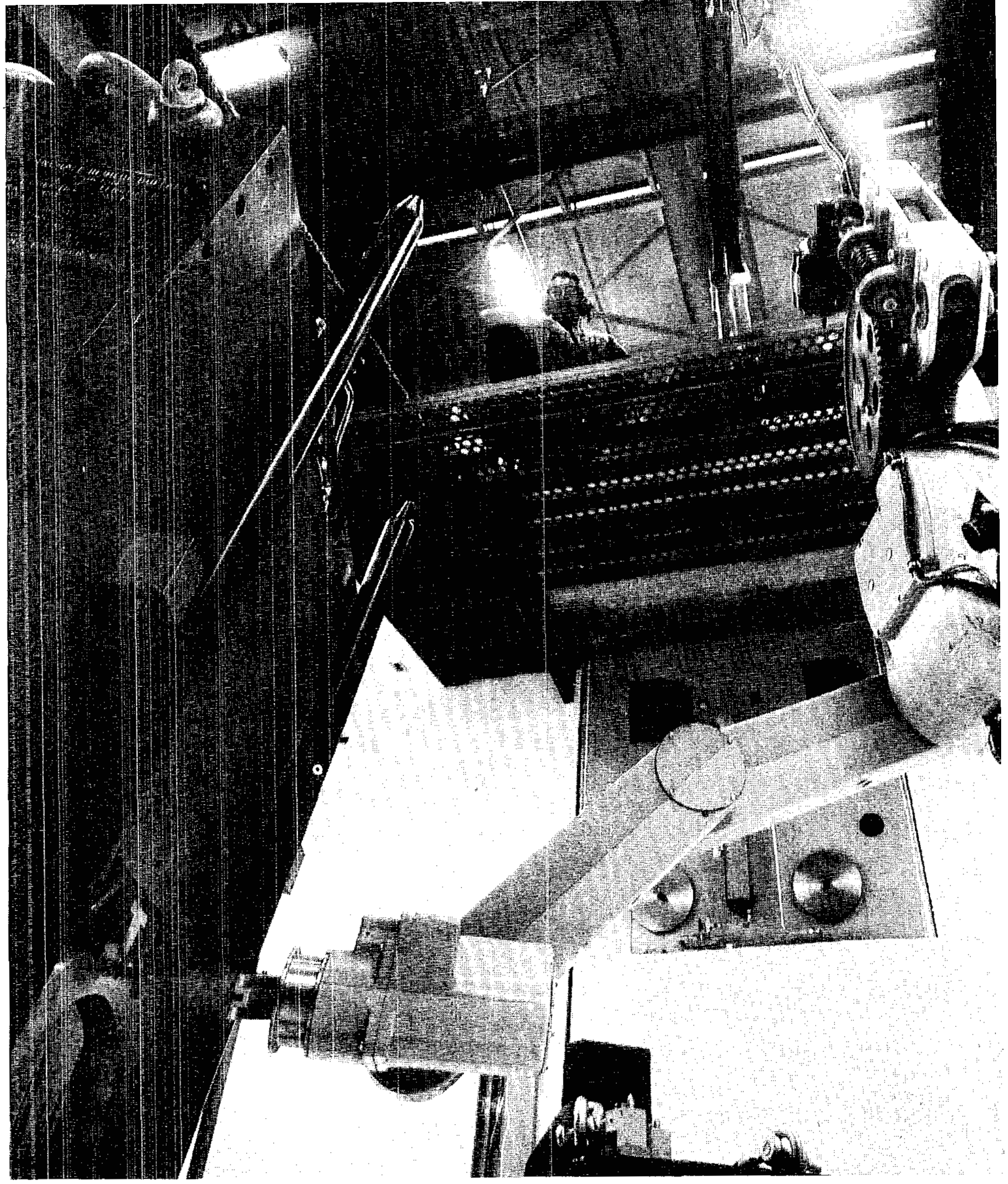
For researchers, the tests provide intensities of radiation, heat, and particles impossible to create in laboratories. As an example, Group J-7 set up a gamma-ray-initiated laser experiment for Group J-14 using an ingenious gold-plated "light pipe" to channel gamma rays to a lasing cavity. Only a nuclear detonation could have produced gamma rays of sufficient energy to make the experiment possible.

While purely scientific experiments have often been "piggy-backed" with weapons research in underground testing, the opportunity to conduct experiments in unusual and extreme conditions has created increasing interest in conducting underground tests for purely scientific reasons alone.

If and when that happens, you can be sure that the personnel of Group J-7 will be there, trying to figure out where to place the diagnostics so that one piece of equipment won't get in the way of another, trying to get that ornery "string bean" of a rack to "stand still" to 1/16 of an inch, and sweating it out in the hot Nevada sun until the earth shakes to tell them that the product of their many months of hard work has just been vaporized in the interest of science.

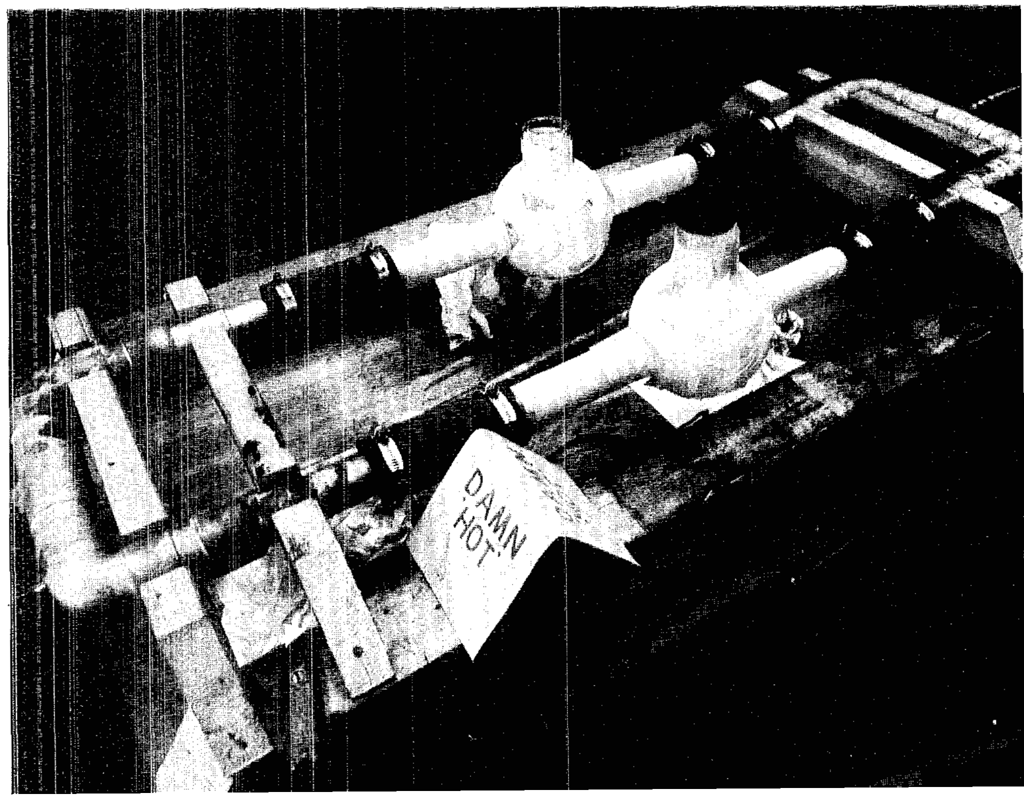
And then the men of Group J-7 will return to Los Alamos to "rack 'em up" again.

Photo Shorts



Like a giant dentist's drill, a manipulator on an articulated hydraulic boom descends to tighten a bolt on a target cell on the beam line at LAMPF. Group MP-7, here demonstrating the device while the beam was not in operation, would normally operate it remotely by closed circuit TV.

Group MP-7 has a good feel for effective communications, too, as shown on the sign by the double-barrelled cold trap, below right. Actually, the device is extremely cold, due to the circulation of liquid nitrogen, and is used to condense moisture from other gas used in the EPICS (Energetic Pion Channel Spectrometer). But if you touched it, the effect would be the same as a burn.



The American Revolution
once over lightly

A garrulous John Adams whose talk, talk, talk drives his Continental Congress colleagues up the walls of Independence Hall, a fly-swatting John Hancock, a love-smitten Thomas Jefferson unable to find the right words for an important message to King George III, and a gout-ridden Benjamin Franklin unable to persuade the Congress to free slaves—all singing of their yearnings and frustrations, of their triumphs and despairs, of their loves and hates. These are the men who ignited the American Revolution?

Yes indeed, according to the Los Alamos Light Opera in presenting their rollicking musical, *1776,* now at the Los Alamos Civic Auditorium. Or, at least, they could have been. Our nation's founders come across as men noble in purpose, but very, very human in their foibles. It all adds up to engrossing drama and light-hearted comedy, to lilting song and artful stagecraft that would rank creditably on Broadway, which is where *1776* came from in the first place. After its opening there in 1969, one enthusiastic critic called it "a great story—might run until 1976." It has, if not on Broadway, then in communities, such as Los Alamos, endowed with the talent and capability for staging sophisticated productions.

That Los Alamos has the talent is due to the considerable musical and dramatic skills found among Los Alamos Scientific Laboratory personnel and their families. That it has the capability is due to the organization that puts it all together, the Los Alamos Light Opera.

It all started in 1948 when members of the Los Alamos Choral Society, hankering for a change of pace from serious music, recruited members of the Little Theater and the Community Orchestra to stage Gilbert and Sullivan's *H.M.S. Pinafore.* The show was a box-office success, leading to the presentation of *The Pirates of Penzance* the following year. In 1950, the Los Alamos Light Opera was officially incorporated and staged another Gilbert and Sullivan, *The Gondoliers.*

More Gilbert and Sullivan operettas followed until 1956 when the group felt willing, ready, and able to tackle more contemporary works, and presented *Finian's Rainbow.* Since then, the Light Opera has staged other Broadway hits such as *Guys and Dolls, South Pacific, Annie Get Your Gun, Kiss Me Kate, My Fair Lady, Man of La Mancha, The King and I, Fiddler on the Roof, Can-Can, Once Upon a Mattress,* and *Boy Friend.*

Among the early pioneers of the Light Opera participating in the *1776* production are Ray Gray, M-4, Ed Spence, and Roger Lazarus, C-DO. Heading the staff for *1776* are John Lunsford, CMB-8, director; Don Gerheart, musical director; Sue Wooten, ISD-2, production manager; Karen Stapleton, choral director; Jody Shepard, set design-

Not looking for props in garbage cans, but dying a woven drop for a stage setting, are Lester Hoak, L-6, and John Lunsford, CMB-8. Despite a record of box-office successes, the Light Opera scrimps to help pay royalties.

Getting some extra attention to his makeup from Nancy denHartog, makeup director, for his role as Benjamin Franklin is Roger Lazarus, C-DO. Realistic makeup is credited for adding much to the excellence of the show.

As opening night draws closer, tension mounts during dress rehearsals—but not enough to preclude moments of levity as John Lunsford, director (right), explains some of the stage "business" he wants to, left to right, Tim Burns, Karen Stapleton, Eric Jones, J-10, and Roger Lazarus, CD-0.

er and stage manager; Sandra Musgrove, choreographer; and Carolyn Buckner, costume mistress. This year's "unseen star" may well be Nancy denHartog, in charge of makeup, whose artistry transforms a 20th-century cast into living replicas of 18th-century revolutionaries.

The leads on stage include Eric Jones, J-10, as John Adams, Lazarus as Benjamin Franklin, Tim Burns as Thomas Jefferson, and Jerry Kestell, ENG-14, as John Hancock. Casting the production posed an unusual problem with 25 male roles to be filled and but 2 female roles. However, an intensive interviewing program resulted in all male parts being cast.

If female roles are few in number, they are vital to the plot. Karen Stapleton, as winsome Martha Jefferson, enchants not only her husband but old Benjamin Franklin and crusty John Adams. Suzanne Robinson portrays an Abigail Adams whose love sustains her husband during tribulation.

1776 opened Friday, December 5, and held its second performance Saturday, December 6. Concluding performances are scheduled for 8:15 p.m. December 12 and 13 at the Civic Auditorium.

It's all designed to begin Los Alamos' Bicentennial celebration in a spectacular, star-spangled way. If the talent and joyful *elan* shown at rehearsals are portents, *1776* will be a resounding hit, which poses an unforeseen problem for the rest of the Bicentennial year.

What do we do for an encore?

Operation Skyhook

In pursuit of their craft, dauntless Los Alamos Scientific Laboratory photographers have strapped themselves outside of helicopters, been lowered into downholes at the Nevada Test Site, "tight-rope-walked" on I-beams over a 600-foot-deep canyon, climbed into sodium furnaces, been lifted in cranes, and hung from rafters. But until Saturday, October 25th, none, at least on Laboratory assignment, had been lofted in a balloon.

Thus, it was a first of sorts when photographer Bill Jack Rodgers, ISD-1, went aloft in a hot-air balloon piloted by Emily Wenz as, on the ground, her husband George Wenz, H-1, supervised the filling, tethering, and launching of the balloon to an altitude of about 100 feet. Taking photos of the launch, pulling tethers, and assisting in general were Bill Regan, ISD-1 group leader, Frank Berry, ISD-7, Jim Bergauer, ISD-7, Charles Mitchell, ISD-6, Don McCormick, DIR-FMO, and curious bystanders.

It would be vivid writing, but poor reporting, to recount sudden crises and last-minute heroics to "save the day," but in fact, the mission was accomplished smoothly and without incident. Rodgers got his photos of land at TA-3 being considered as the site for a proposed construction project.

"We went ballooning because it would give us the low-angle aerial photos we wanted. There was no suitable nearby structure to shoot from, an airplane couldn't fly low enough, and renting a helicopter would cost too much. We knew of the Wenzes' ballooning interest and they agreed to provide my 'skyhook,'" Rodgers said.

More than casual buffs, both Wenzes hold commercial pilot ratings for balloons, which means they can instruct and carry passengers for hire. Their involvement in ballooning began in Albuquerque in 1973. Since relocating in Los Alamos last year, their local flights have been in the vicinity of San Ildefonso Pueblo. The Wenzes enjoy competition, and last year George was ranked first nationally because of his performance at races around the country. He participated in the nationals at Indianola, Iowa, last August, but failed

Bystanders haul the balloon out of the gondola.

The big blow-up begins as hot air billows the balloon.

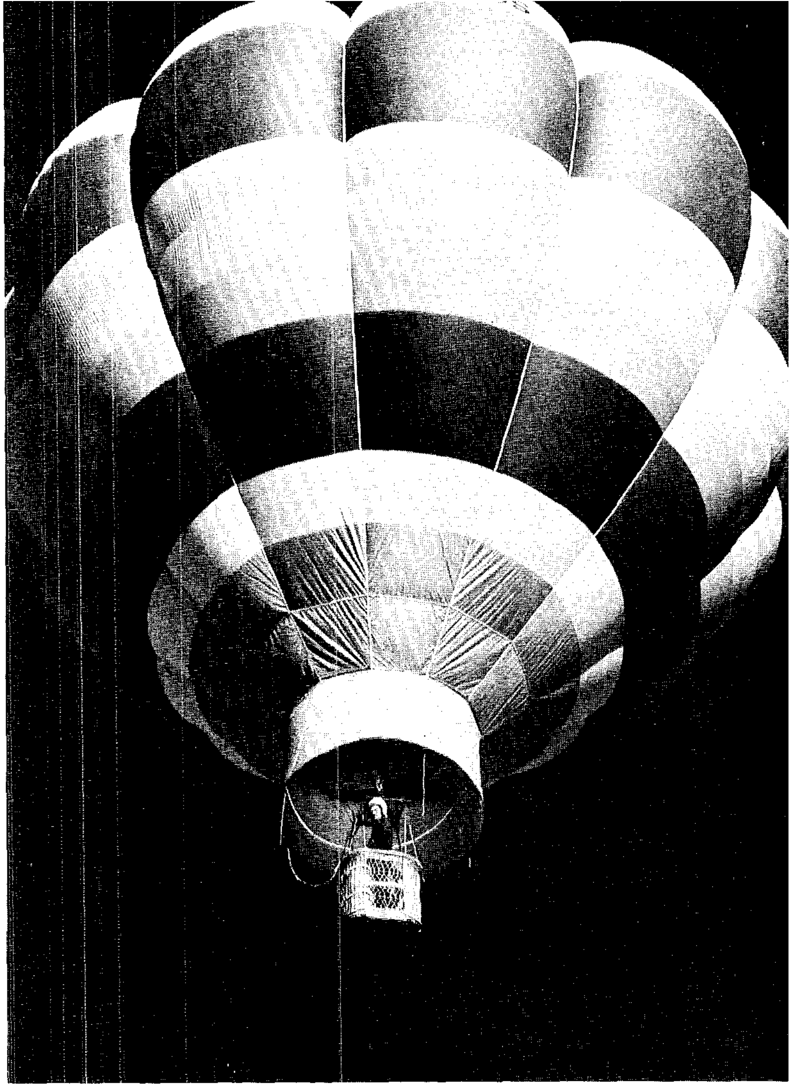
to bring home a trophy. "You need luck as well as skill to find the altitudes at which winds will carry your balloon toward where you want it to go," he comments.

George considers ballooning to be a safe sport when conservatively pursued. His closest approach to an accident occurred when he was demonstrating touch-and-go landings to a passenger. An unexpected gust tipped the basket horizontally on the ground and his surprised passenger tumbled out. The lightened balloon shot up a hundred feet or so, leaving his passenger stranded. However, a chase crew later picked up the "man overboard" with no harm done.

To George's knowledge, only one other hot-air balloon has been reported in the vicinity. He would like to find out who the balloonist is in hopes of forming the nucleus for more widespread local ballooning activity.

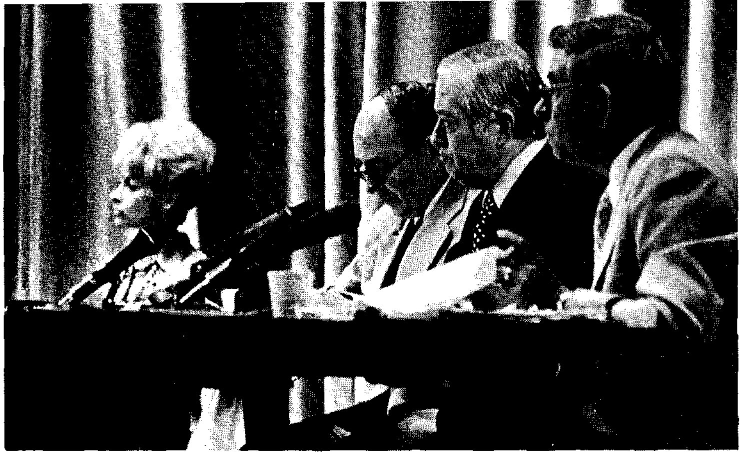
Meanwhile, would-be balloonists can contact the Wenzes. They promise to provide information on the subject that will be something more than hot air.

Answer to quiz on back cover: a density-differential supported skyhook, or hot-air balloon. The photo was taken by Rodgers from the balloon's gondola looking up into the balloon.



George and Emily Wenz keep a watchful eye on preparation.

All aboard—and away we go!

Harold Agnew, LASL Director, delivers a few informal remarks, then gets down to business in making his statement supporting financial assistance to Los Alamos Schools and the County to Senator Montoya and Representative Lujan (right center and right). Also shown are Betty Lanphere, recording reporter, and William Parler, Chief Counsel to the JCAE (left and left center).

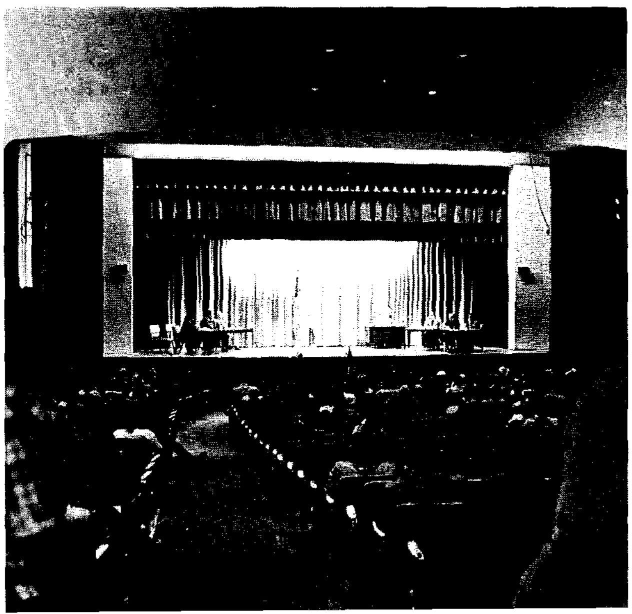
A Visit from Washington

On Tuesday, October 14, Los Alamos residents turned out in large numbers to attend a hearing held in the Civic Auditorium of the Los Alamos High School by U.S. Senator Joseph Montoya (D.-N.M.) and U.S. Representative Manuel Lujan, Jr., (R.-N.M.) for the Community Subcommittee of the Congressional Joint Committee on Atomic Energy.

The hearing pertained to legislation being introduced by Montoya and Lujan to assure continued federal financial assistance to Los Alamos Schools and to the County. The proposed legislation would supplant existing legislation expiring soon, and would authorize federal assistance indefinitely.

The presence of top officals both from Washington, D.C., and from Los Alamos underscored the importance of the event, and demonstrated once again the continuing interest of New Mexico's Congressional delegation in the future of the Laboratory and the community.

Presenting testimony urging continued support, above, are Los Alamos school officials Duane Smith, superintendent; Paul Goodfellow, business manager; Orlando Lucero, high-school student representative; Walter Smith, assistant superintendent; and Peter Salgado, school board chairman. Below, county officials Richard Daly, WX-3 and member of the County Council; Abner Schreiber, county attorney; Neil Seeley, county administrator; LeRoy Starkey, finance director; and Richard Gettzinger, L-3 and chairman of the County Council, describe civic needs.



DON'T BE A SKI DUMMY

Last year, there were 114 serious accidents, most involving Los Alamos Scientific Laboratory employees and their families, at the Los Alamos Ski Club. Injuries ranged from lacerations to those which incapacitate, such as broken femurs and concussions.

In an effort to reduce the toll, the suffering, and the considerable loss of work time from the Laboratory, Joe Devaney, L-5, and a longtime member of the National Ski Patrol, offers these safety suggestions as the skiing season begins:

1. Ski with the right attitude. The mature skier enjoying the sport with a prudent attitude is rarely hurt. The careless, reckless, or show-off skier often is. This is skiing's most important safety rule as it leads to knowing and obeying all others.

2. Get instruction. More so than in most other sports, the happiest and safest way to start is under the tutelage of a competent instructor. The Los Alamos Ski Club provides top-notch instruction.

3. Exercise. You need not train as if for the Winter Olympics, but should have reasonable health, vigor, and muscle tone. If you can't get up, without skis on, from a sitting position without rolling to your hands and knees first, better train.

4. Use short skis. If you're a beginner, use skis as short as 120 centimeters (barely chest-high for average builds), graduating to longer skis later, if you wish. Because you can handle short skis more easily, and because the lever-arm twisting your leg in a fall is shorter, they are safer.

5. Adjust bindings properly. Store settings are often too tight. Set a binding so that, with a friend standing on your ski, you can twist out of it in all directions without pain. While skiing, you may progressively tighten bindings, very slightly each time, if they release too frequently. Back off on the setting if you begin to feel pain as bindings release. Some bindings should be periodically lubricated, and proper anti-friction plates should be installed. Bindings can jam and freeze; check them before and occasionally during skiing.

6. Control your falls. If possible, fall on your seat or torso rather than on a knee or elbow. Try to keep legs together. Avoid putting out an arm, except in rough terrain to protect the rib cage and head (but don't "stiff-arm"). Roll, if you can, while avoiding limbs-akimbo positions. Protect your head after you're down until everything, particularly flailing skis, comes to rest.

7. Avoid collisions. Make a last-second sideways leap, falling deliberately to avoid an unforgiving tree. An unavoidable low obstacle, such as a rock, can sometimes be overriden by leaning back a little to raise ski tips and hitting the obstacle squarely with skis parallel and together. When stopping, do so to the side of traffic. Before starting again, look uphill for approaching skiers. The overtaken skier has the right-of-way—if passing one, keep clear and call "passing left!" or "on your right!" Wild skiing invites collisions and possible loss of one's ski pass or a costly damage suit.

8. Use lifts properly. If a beginner, ask the ski patrol or lift operator for instructions. Tips include tucking in clothes and hair (they can snag) on rope tows, rolling out of the towpath fast if you fall while using a rope, T-bar, or poma lift (the metal edges of the skis behind you can cut like knives), never strapping poles to wrists on any lift, and leaving landing areas promptly.

9. Be "best dressed." Clothing that is too heavy will make you sweat and then freeze. Clothing that is too light leads to chilling and fatigue. Use multiple layers of clothing (the outer being wind resistant) so that you can peel or add layers. Boots must be tight enough for control, but not enough to restrict circulation, causing pain and possibly frostbite. Wear a face mask in extreme cold when frostbite is a danger—warm a gray-white waxy patch on your skin at once.

10. Check your children frequently. They are much more vulnerable to cold and less able to cope with emergencies.

11. Know what to do about accidents. Place crossed skis sticking up in the snow uphill of a victim. Send a messenger to the ski patrol, making sure he can describe the location. Keep the victim still and warm, borrowing clothes if necessary, and don't move the injured part.

12. Obey avalanche-warning signs. Don't venture beyond patrolled areas until you learn nature's warning signs for avalanches and what to do about them. The ski patrol can advise.

For Safety and Courtesy

1. Don't ski fast in beginners' areas.

2. Don't pass slower or stopped skiers close by.

3. Always stop below other stopped skiers, never above.

4. Do not ski through classes.

5. Stop, or prepare to stop, when leaving a trail and entering an open ski area.

6. Slow down and give way at trail junctions.

7. Ski slowly when approaching lift lines.

8. Give wide clearance to rescue toboggans.

9. Wear ski restraints to prevent your skis from breaking loose (required at most ski areas).

10. Move out of the way of a loose careening ski, and warn others downhill by yelling "ski!"

Cross-country touring has its own special rewards and risks, requiring proper knowledge and equipment. The ski patrol can advise.

short subjects

The death of **Clinton P. Anderson,** former U.S. Senator (D.-N.M.), was felt keenly at the Los Alamos Scientific Laboratory. During his 4 terms as U.S. Senator, serving in 2 of them as chairman of the U.S. Joint Committee on Atomic Energy, Anderson was a vigorous proponent of nuclear research and the continuing development of the Laboratory as a leading national research institution. His name lives on in Los Alamos at the Clinton P. Anderson Los Alamos Meson Physics port, and a section of State Road 4, marked by a monument, named the Clinton P. Anderson Highway.

Anderson's political career included serving in the U.S. House of Representatives and as Secretary of Agriculture in the Truman administration. He retired from political life in January, 1973, celebrated his 80th birthday October 23, and died of natural causes on November 11.

Honors: **David Edwards,** L-7, has been awarded a 5-month research visit, beginning in January, to the USSR by the American National Academy of Sciences under an exchange program between the Academies of Sciences of the U.S.A. and the USSR. Edwards is one of the first American physicists to be invited for an extended exchange visit at the P.N. Lebedev Physics Institute, Moscow, where he will work with Professor A. M. Prokhorov, a Nobel laureate, Lenin-Prize winner, and member of the Soviet Academy of Sciences.

Roderick Spence, Q-DO, was a recipient of a 1975 James H. Wyld Award of the American Institute of Aeronautics and Astronautics "for outstanding achievements in the development or application of rocket propulsion systems." Spence was cited for his work in developing nuclear rocket reactors.

Norman Riechman, SP-1 alternate group leader, was elected national secretary of the National Property Management Association for 1976 at its annual meeting held October 15 in Los Angeles. He is currently president of the Northern New Mexico Chapter of the NPMA.

Louis Fuka, Q-26, has been elected to a 4-year term on the University of California Retirement System Governing Board.

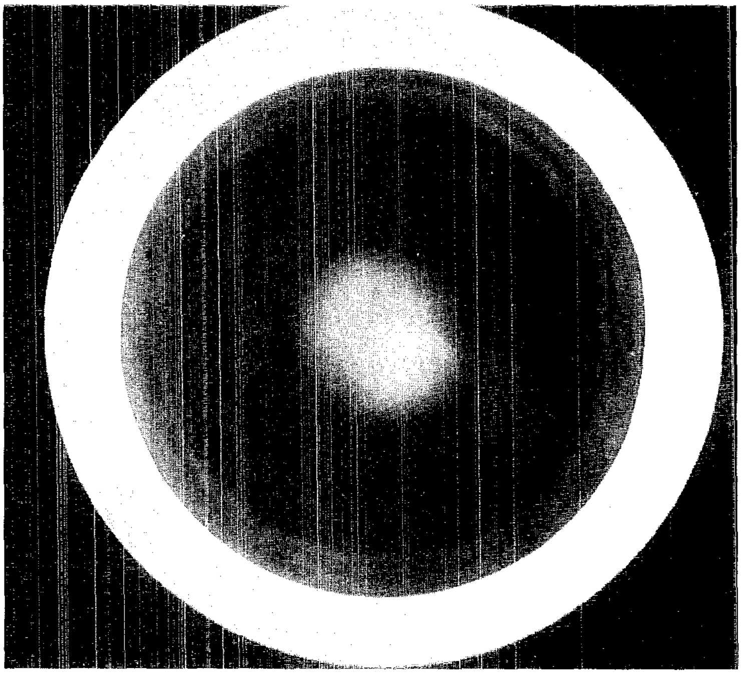
Retirements: **Opal Jasinski,** M-4, senior data analyst; **Laurence J. Brown,** E-2, electronics technician; **James R. Ditto,** WX-3, facilities specialist; **Celedonio O. Martinez,** H-7, waste management supervisor.

Project Periquito, a joint U.S.A.-Canada program to investigate the dayside polar cleft region of the earth's magnetosphere, is under way with teams from LASL, Sandia Laboratories, the University of Texas at Dallas, EG&G, and General Dynamics on station in Alaska and north Canadian regions. The project is similar to Operation Tordo (**The Atom,** January 1975), with 2 launches scheduled for late November and early December to inject barium about 500 kilometers above polar regions so that glowing barium ions may be observed as they delineate the cleft region. LASL test director is **Milton Peek,** J-10, and heading airborne observations aboard 2 NC-135's are **John Wolcott,** J-16, and **Morris Pongratz,** J-10. The launches are part of a 3-year cooperative program between the 2 governments.

Other magnetosphere news: Street lights that would have interferred with a bank of light-intensifying cameras under the direction of **Mel Duran,** J-10, were turned off temporarily Friday, October 3, in hopes of recording barium streaks from an Antarctic barium injection conducted by the Max Planck Institute and the National Commission of Special Investigations in Argentina. Unfortunately the streaks were not detected, presumably due to unfavorable atmospheric conditions.

Deaths: **Barbara I. Crabtree,** PER-1, personnel representative.

Microspheres are imbedded in epoxy, which is then sliced, resulting in many spheres being cut in half. This is a perfect specimen, the coating having been applied by a process developed by CMB-6. This photomicrograph enlarges the cross section 400 times.



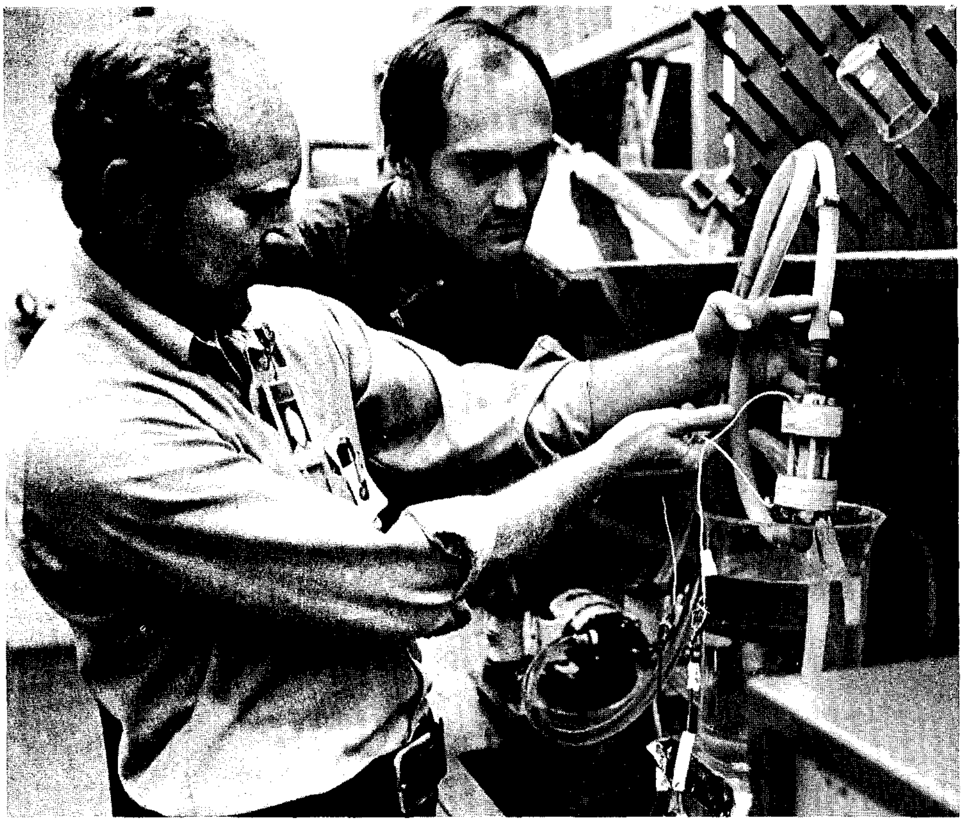
LASL's MICROSPHERE MINIFABRICATION SHOP

Meet the Los Alamos Scientific Laboratoy's minifabrication shop. Officially, its called the Materials Technology Group (CMB-6). The group develops and fabricates the special materials required for many LASL programs. Metals, plastics, ceramics, graphites, etc., are fabricated with designed properties to meet specific requirements—such as components for weapons; high temperature, radiation-resistant ceramic materials for CTR Division's prototype waveguide and side-coupling cavities as well as ceramic insulated steering magnets for the MP linear accelerator; and graphite and carbide-carbon composites for a variety of nuclear reactor applications, just to name a few. While handling assignments such as these demands expertise and precision (for example, the first wall of CTR's proposed Scyllac Fusion Test Reactor will have to withstand repeated thermal, chemical, and radiation stresses more severe than for any other known application), at least CMB-6 and the Shop Department work with palpable objects amenable to rough-forming, followed by finishing by customary machining methods.

But about 3 years ago, CMB-6 was thrown a curve—or, to be more accurate, a spherical curve. The "culprit" was L-Division. The assignment: "Give us perfect hollow spheres with tolerances 100 times tighter than normal standard tolerance, with the capability of producing multilayers of a variety of materials on a number of substrates, and the technology to manufacture them."

So far, so good. Then came the "curve." "By the way," L-Division added, "the spheres must be 1000th of an inch in diameter—about the size of a speck of dust. We're going to need them for laser-fusion tar-

Microspheres are classified according to size by CMB-6's Haskell Scheinberg, and John Magnuson. Here, microballoons are vibrated, rotated, and drawn by suction through a very fine screen.



Tony Mayer and Duane Catlett, both CMB-6, set up an electrolytic plating apparatus invented by Mayer. Reversal of fluid flow in the cylinder causes spheres to migrate from one end to another, becoming coated while in contact with screens at ends.

gets, and we'll need to be able to produce a lot of them."

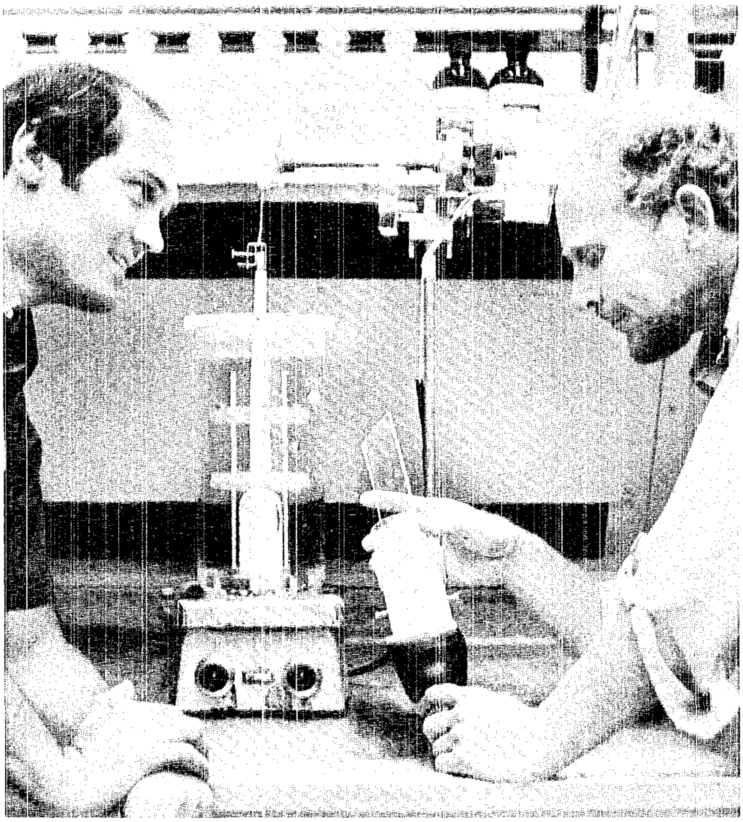
Such small objects, in a nether world between the microscopic and the visible, cannot be fabricated or machined by conventional means. Desired surface finishes cannot be achieved by machining; the surface finish of the microspheres must be inherent in the process itself. How does one handle anything so small? A whole new approach to materials technology was required—a completely new "minifabrication shop" technology. In developing these technologies, CMB-6's work complements, but does not duplicate, that of Group L-4 (laser experiments and diagnostics) as reported in *The Atom,* November-December 1974. Group L-4 separates "1 in a million" perfect pellets from raw batches, manufactures and mounts targets to be "shot" with a laser, on a daily basis. Group CMB-6 is chartered to develop the reproducible techniques for coating the commercially obtained hollow microspheres to yield targets of any design desired by L-Division. Eventually, developed machines and know-how are transferred to Group L-4 to be used by them on a production basis.

Back-and-Forth Electroplating

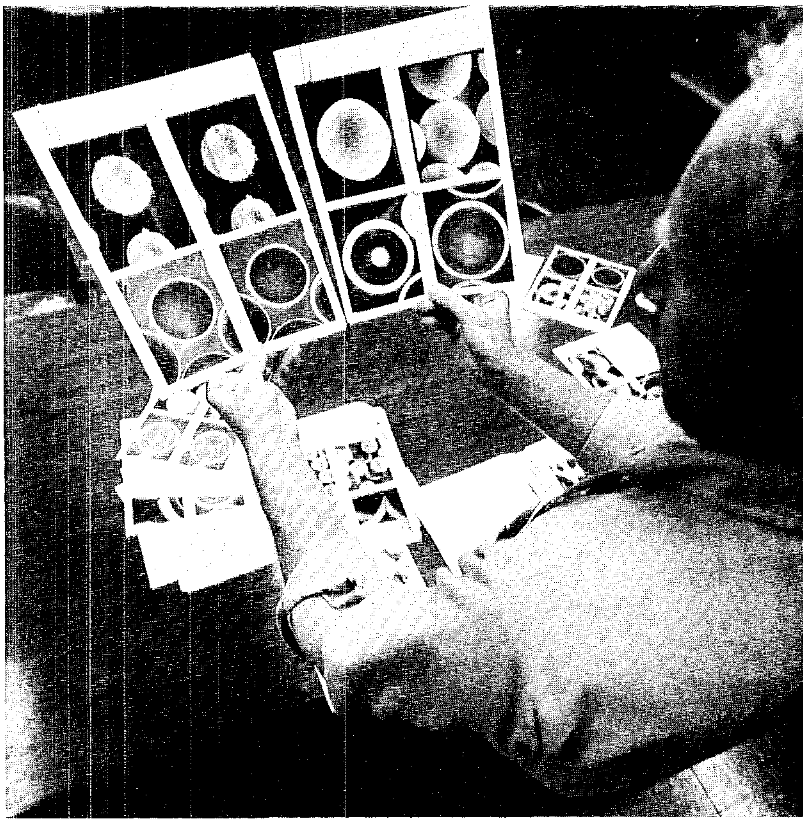
Not all laser-fusion targets are glass. Some are metal. And some are metal that is coated with another metal, either for reason of physics design or to provide additional strength to contain the high pressure deuterium-tritium gas. One technique CMB-6 developed is based on a principle familiar to any teenager who has ever had a bumper or a hubcap chrome-plated—electroplating.

The part to be plated is attached by a wire to an electrode and suspended in a plating bath, or electrolytic solution. Passing current from another electrode through the electrolytic solution causes metal in the solution to be deposited on the suspended object.

The difficulty with electroplating microspheres is how do you attach a great many of such tiny particles and suspend them in a solution?



Catlett and Mayer compare the original hand-pumped device for electroless plating of microspheres to its successor, an automated model, in the background. Agitation by a diaphragm keeps microballoons suspended in solution. Results are excellent, but coatings are limited to a few metals.



Mayer checks photomicrographs showing specimen microspheres and hemispheres enlarged 500 to 1000 times. Photos on the left are of imperfect microspheres, those on the right are of perfect ones produced by the electroless method.

And even if you could, how do you prevent flaws in the coating where the conductor is attached? The requirement for any laser-fusion target is that it be a perfect sphere and that all coatings be uniform.

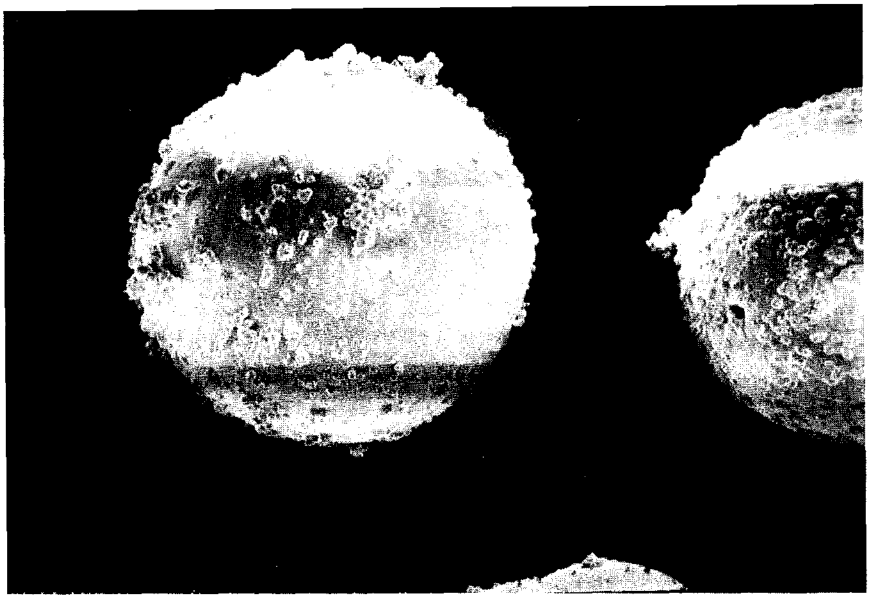
Tony Mayer, CMB-6, came up with a simple device for electroplating microspheres using a porous cylinder, a reversible pump, 2 fine-mesh screens, and a timer. A batch of microspheres is placed in the cylinder between the 2 screens, which are at the ends, and the cylinder is immersed in an electroplating solution. The pump is started and the gentle flow of the solution impresses the microspheres against one of the screens. Current is turned on and the screen in contact with the microspheres becomes the negatively charged cathode. An anode is placed outside the porous cylinder to complete the electrical circuit. Since the microspheres are in contact with the cathode, electroplating takes place.

But what of the portion of the sphere in contact with the screen? It is not electroplated. If the sphere were to remain in that position throughout the electroplating process, it would emerge with the screen pattern impressed on the surface of one side—and be entirely unusable.

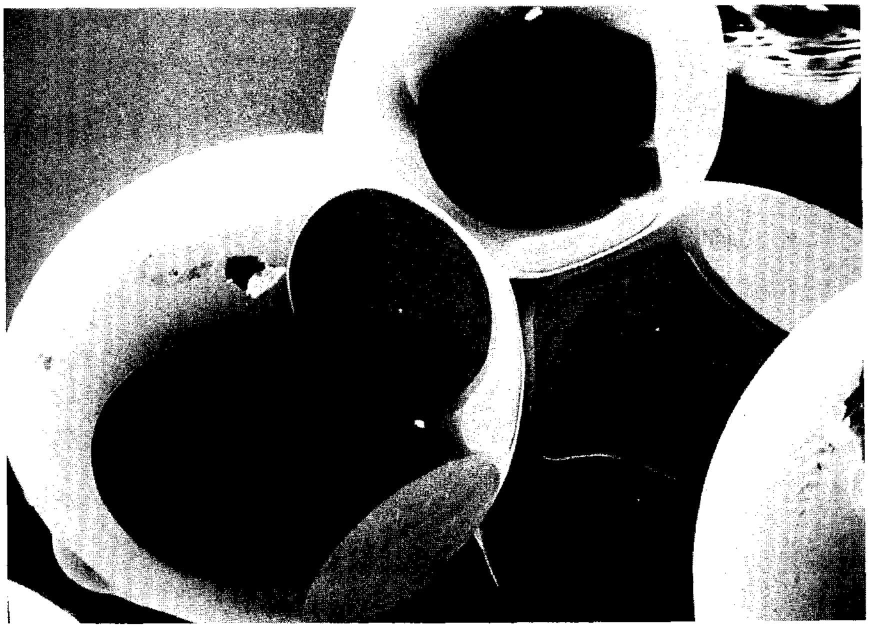
But the microsphere is in contact with the screen only for seconds. The timer signals the reversible pump and the fluid reverses its flow direction. At the same time, the cathodic current is switched to the opposite screen; the "off" screen becomes the cathode screen and vice versa. The microballoons flow en masse to the screen at the opposite end of the cylinder where the process is repeated.

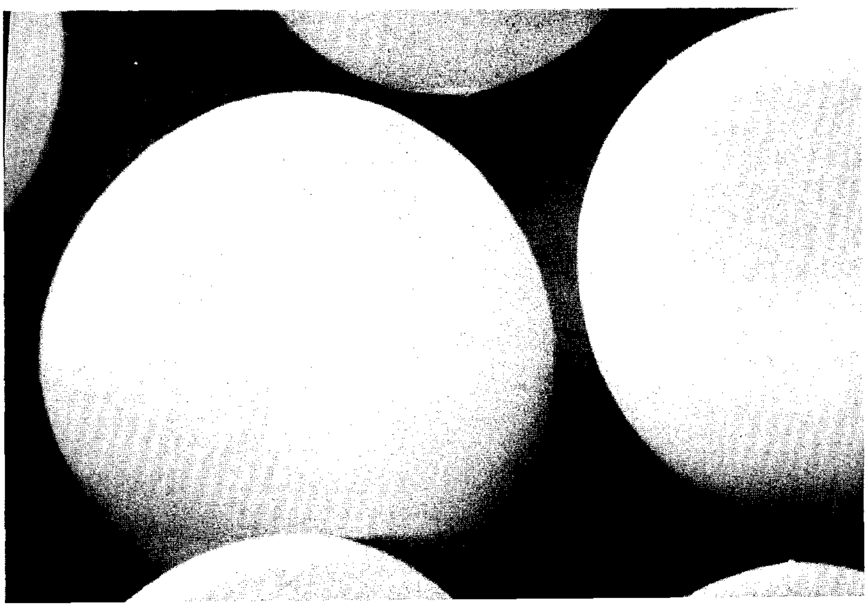
Perhaps 1000 times this reversal takes place. The principle of randomness assures that most of the spheres will contact the screens at different points on their surfaces many times during a plating operation, assuring a uniform coating.

The device is unique and a patent application has been filed. By using this technique, about 30 metals from the periodic chart can be applied with great precision to a



All sorts of things can go wrong in coating microspheres, such as the very bad deposit produced in an early, unsuccessful experiment, above, and the agglomeration, or sticking together, of spheres during plating, below. Today, CMB-6 routinely produces perfectly plated spheres as shown in the bottom photo.





variety of microsubstrates, providing L-division great flexibility in choosing the design of future targets.

Swimming for Their Coatings

Another device for coating microspheres in an aqueous solution, also suggested and developed by Mayer, accomplishes the coating by an electroless process. Its simplicity seems to be a trademark of the CMB-6 approach to very complex problems.

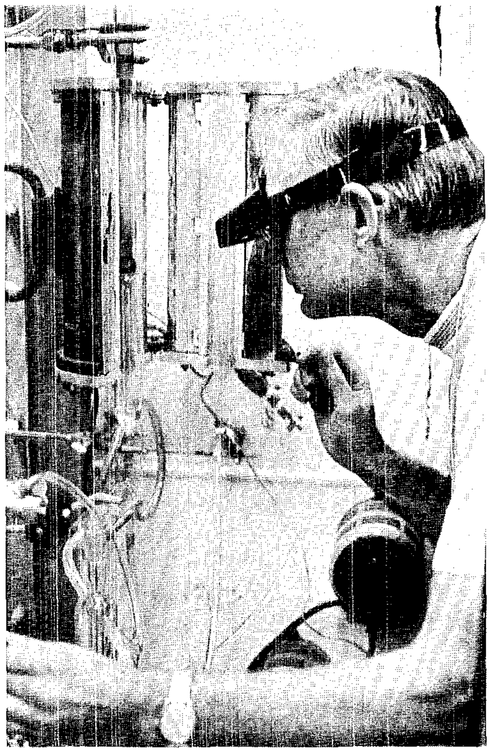
In coating by the electroless process (that is, without electrodes) the metal to be coated is in a solution in which the metal microspheres are suspended. A chemical reagent, or a chemical reducing agent, is introduced into the solution, triggering a reaction in which ions of the metal in solution are reduced to the metal form on the catalytic surface of the microspheres, thus coating them.

The problem with this technique is the same one that plagued the other process developed by Mayer and, in fact, is common to all processes for coating microspheres. How do you create a random motion of the individual microspheres in their coating medium to prevent their agglomeration by being "coated together" and to assure a uniform, coating on each of the microparticles?

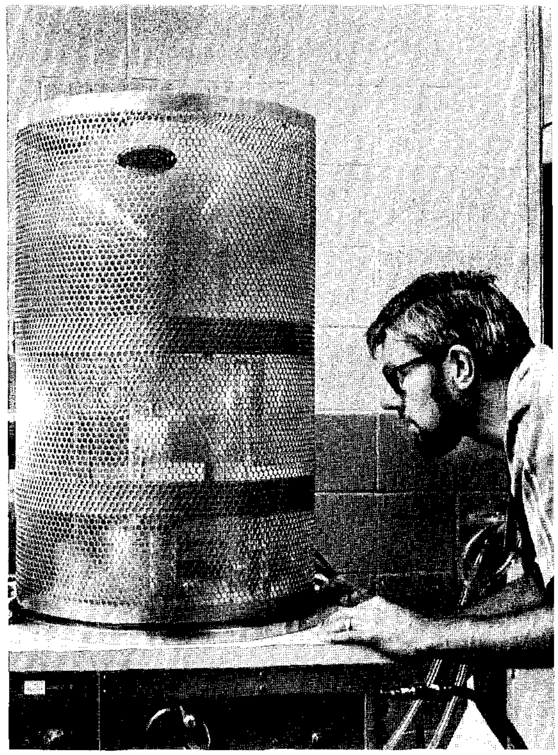
Stirring was first tried as a means of creating random motion. It did not work. Mayer succeeded in creating the proper motion by designing an apparatus with a simple diaphragm arrangement, working much like a "plumbers friend," which keeps the solution and the microspheres homogeneously dispersed in it in constant motion. The first prototype was hand operated. Mayer would simply sit there and pump up and down. He has since added the "luxury" of automation.

The results, according to Duane Catlett, CMB-6 alternate group leader, are the finest, most uniform metal coatings ever applied to microspheres. Only the fact that at present the process is limited to nickel and a few other metals keeps it from being the prevalent technique.

Chuck Javorsky and Jim Bradberry (standing), both CMB-6, view magnified specimens as shown on the opposite page in a metalograph.



Bill McCreary, CMB-6, controls a chemical deposition device. Magnifying eyeglasses give him a little better view of what's going on.



Garry Simonsic, CMB-6, operates a glow discharge polymerization coater. Microspheres are levitated electrostatically and mechanically for uniform coating.

Group CMB-6 has developed with varying degrees of success other techniques for the deposition of metal and plastics on microparticles. Some of these techniques include sputtering, vacuum evaporation, and chemical vapor deposition (CVD) for metal coatings, and a process called glow discharge polymerization for plastic coatings. Bill Powell, Bob Riley, and Barry Barthell have been working on the sputtering and vacuum evaporation techniques, and Bill McCreary has been evaluating the CVD process. McCreary has had some success with nickel, tungsten, molybdenum, and a molybdenum-rhenium alloy. No metal deposition processes as yet, however, have been quite as successful as the electrolytic and electroless plating methods.

The glow discharge polymerization technique is a rather sophisticated method for coating the microparticles with a very uniform, inert plastic. This process has been used previously to coat larger objects with plastic films. Gary Simonsic modified the equipment and developed the process to the state that both metal and glass hollow microspheres can be reproducibly coated with plastic films of any thicknesses up to 15 micrometers. The plastic films are formed by exciting an organic monomer in the vapor state into luminescence by an electrical discharge. The excited monomer polymerizes on the surface of the microspheres to form a polymerized organic coating. The unique feature of this system is that light microspheres, such as glass, are electrostatically levitated by a high-frequency charge reversal, giving the random motion essential for uniform coating. For heavy microspheres, such as metal, the bottom electrode on which the microspheres are placed is also vibrated to assist their movement.

In conjunction with the microsphere coating development effort, the commercially obtained microspheres of glass and metal must also be quality upgraded and size-classified. Techniques for accomplishing this have been developed in mutual cooperation between groups L-4 and CMB-6. The CMB-6 portion of this effort is being performed by Haskell Sheinberg and John Magnuson.

Another support activity is that of analysis of the coating deposited on the microspheres. As an example, microspheres may be "frozen" in a block of epoxy. The block is then cut and polished. Examining the sliced surface under magnification will reveal many of the spheres cut in half, allowing cross-section analysis. Scanning electron microscopy is also used extensively to observe the quality of the surface of the coatings. Chuck Javorsky and Jim Bradberry perform all of these analyses and by their consultation assist in coating-process development.

CMB-6 is a rather large group with several technical sections and 4 shops located at TA-3. But size is not what makes CMB-6 unusual. What characterizes CMB-6 is that it is a melting pot where metallurgy and chemistry, engineering and technology, fabrication and industrial processes all blend. Every day seems to bring new challenges in handling materials or developing devices to meet special-materials needs unlike that of the day before.

The group is somewhat of a microcosm for LASL as a whole: an interdisciplinary organization in which many talents and personalities are coordinated in achieving common goals. But in the free-wheeling "think-tank" and "try-it-out" atmosphere of CMB-6, "the synergistic effects are tremendous," as Catlett puts it. "There's a stimulation here from the crossfertilization of various fields of expertise that result in 1 and 1 adding up to more than 2. Many of our people, regardless of their original fields of expertise, become jacks of all trades, and pretty close to masters of them all."

Which is probably the main reason why creating a "minifabrication shop" for manufacturing hollow microspheres for laser-fusion targets, while assuredly different from their "normal" type of challenge, isn't all that formidable a problem after all.

10

years ago in los alamos

Culled from the November & December, 1965, files of The Atom and the Los Alamos Monitor by Robert Y. Porton

Give a Dam:

The final paper work was taken care of Sunday on the $50 million Cochiti dam on the Rio Grande which will provide an additional recreation facility for the Los Alamos area. The Governor of Cochiti Pueblo signed an easement making it possible for the Corps of Engineers to build the 251-foot high, 5½-mile long dam. The ceremonial took place before a crowd of 2,000 that included the Governor of New Mexico and the state's two U.S. Senators. Work is expected to be finished in 1970—the same year that will mark the completion of the San Juan Diversion Project. Water for the lake will come from the city of Albuquerque's allocation, some 50,000 acre-feet annually.

Funds Released:

The Bureau of the Budget Wednesday released $1.2 million for architecture and engineering work on the Los Alamos Meson Physics Facility, according to a release from the office of U.S. Senator Clinton P. Anderson. This vastly improves the Los Alamos Scientific Laboratory's chances of getting the particle accelerator.

Award:

The Civil Defense Fallout Shelter Handbook prepared by the Los Alamos County Civil Defense organization won the first place award for special CD publications at the fourteenth annual meeting of the United States Civil Defense Council that was held in Las Vegas, Nevada, last week. The handbook, compiled by a number of LASL employees, was distributed to all shelter assignees in the county. The award plaque will be exhibited in the Laboratory's museum.

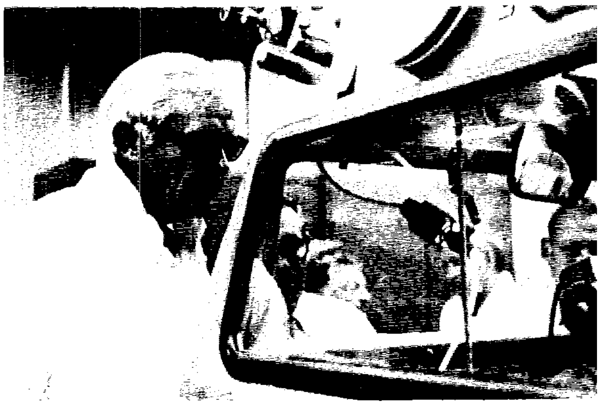
Travel:

Serafico Segovia, a metal cutter in SP-3 and one of the Laboratory's most unusual commuters, retired this month. Segovia joined Project Y in 1942 as an Army employee and joined the University in 1945. For all his 22-plus years, Segovia lived in Santa Fe and commuted, but he never drove an auto. For many years he arose at 4 a.m. to catch an army bus and, in later years, was a member of various car pools. He estimated he traveled some 350,000 miles getting back and forth to work.

Among Our Guests

A Controlled Thermonuclear Research materials team from the U.S.S.R., headed by L. Goilubchikov, visited LASL on Oct. 9 and 10. Among their activities: discussions of LASL's proposed Intense Neutron Source, tours, and posing with their LASL hosts for this group picture. An unidentified strolling feline momentarily "stole the show," much to the visitors' amusement.

ERDA Administrator Robert Seamans, Jr., visited LASL on Oct. 8 to inspect both the Laboratory's present plutonium facilities and facilities under construction on Pajarito Road. Here Seamans sees how materials are handled in a dry box at DP-West. Bill Maraman, CMB-11 group leader, to the right of Seamans, was on hand to answer questions.



Robert Fri, ERDA deputy administrator, visited LASL Oct. 14 and 15 to play a prominent role in the Third Life Sciences Symposium, sponsored by H-Division and ERDA's Division of Biomedical and Environmental Research. Here, Fri addresses a group in the Administration Building Auditorium.

Nobel Laureate Luis Alvarez, physics professor at the Lawrence Berkeley Laboratory of the University of California, was the featured speaker at the 9th annual meeting of the LAMPF Users Group on November 10. He presented a scientific analysis of the assassination of President Kennedy. Here he enjoys a coffee break with Donald Hagerman, MP-DO (left).

Edward Mason, a member of the Nuclear Regulatory Commission (NRC), visited LASL in October to review current programs being carried out by LASL for the NRC, and to discuss projected programs. Here he talks things over with Richard Taschek, ADR, shown in the foreground.

Above is a photo of (check one):

- ☐ A new hybrid petunia by Group H-6 (agricultural bioscience)
- ☐ Diffraction of laser light passing through deuterium-tritium plasma
- ☐ Portion of a density-differential-supported skyhook
- ☐ Image formed by new photometric analyzer with kaleidoscope optics

(See page 15 for correct answer)